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Efficient Substitutes in Industry.

THE acceptance of the principle of large amalgamations in industry involves a number of new and interesting questions.

Attention has been drawn to one of these by the recent death of Dr. Felix Deutsche, the head of the Allgemeine Elektricitäts Gesellschaft, who, after forty years' continuous personal attention to the building up of the vast organisation of that concern in Germany and throughout the world, found himself, toward the end of his career, up against the difficulty of finding a suitable successor. During the lives of the Rathenaus they were the recognised heads with Deutsche always in position to preserve continuity and consistency, but when they passed away Deutsche was himself no longer young, and he entertained hopes that he would be succeeded by his son just as had happened in the case of the first Rathenau. In this he was apparently disappointed, for, according to an article published in the *Deutsche Volkswirt* and quoted from in the *Financial Times* a week or two ago, he called into being just before his death a committee of five, who were to be entrusted with the general management of the A.E.G. It is stated that he had done his utmost to acquaint his son with all the intricacies of management, but for some unstated reason things did not work out according to plan or aspiration. Emphasis is laid upon the fact that Felix Deutsche, the successful organiser and manager, was not brought into the business from outside, but grew up with the concern whose destinies he had ultimately to control.

The writer of the German article quoted above treats the problem as a new one where gigantic and historic concerns have had such origin and have remained for many years under the same more or less personal

influence and control. The problem of the future management becomes keener when there has been continuity in the hands of what we sometimes call a "superman." It may be recalled that both the Rathenaus and Deutsche passed out suddenly and, subject as we all are to human vicissitudes, business organisations will do well to profit by this German experience, for, though our knowledge of the details is small, it seems strange that so well-arranged a combine should have left such a measure until so late in the day, thus occasioning the need for sudden calling into existence of a committee of five. Another great German industrial combine is quoted where the general manager is acting with greater foresight, for he "is known to be steadfastly and designedly training up others to replace him when the time comes for him to lay down the reins of management."

We feel sure that the foregoing facts and comments can be profitably treated as having a bearing upon industrial developments that are taking place in this country, but we do not regard them as being limited in interest to the largest concerns. The principle of securing efficient substitutes for leading men is important in businesses of humbler and less ambitious proportions as well, and it should run down departmentally too among men, who, leaders in their own sphere of operations, may occasion a degree of disorganisation if they have not efficient seconds at command in times of emergency.

Big electrical businesses may have dominant personalities at their head; by whatever name their company or companies have become known, the personality and name of the long associated leader are always linked up with them. Such men will do well to consider whether the A.E.G. succession problem has been sanely handled in their own organisations. It is a matter of supreme satisfaction that the electrical industry has to-day as leaders of some of its companies men who have been responsible for their inspiration from early days and for their subsequent up-building and development. All honour to such men, especially if they have recognised that while continuing to influence policy and impart inspiration, it is their duty, as quoted above, "steadfastly and designedly to train up others to replace them when the time comes for them to lay down the reins."

There may be companies of large size which have no such dominant personalities who have been connected with them and have influenced their policy and growth from smaller days. It may be better for them to organise and develop themselves as a group of specialists in particular departments essential to the making of a complete and efficient board, embracing the different qualifications with regard to finance, management, technics, foreign trade, and the industry generally. Such concerns are possibly being so conducted that the retirement of this or that man would make in the main little difference—there is no great human centrepiece known to everybody as the embodiment of a policy. This seems to us to be, in the nature of things, how our industrial organisations will develop as they become larger and larger. We want supermen less than we want a combination of effective units one of whom is their chosen head. In the course of time there will emerge some who are head and shoulders taller than their fellows, and their names will rank among those of our leaders, though they have not been associated with a particular concern all their days as Deutsche was.

As we mentioned a week or two ago when discussing the personnel of the industry, big men are the product of big opportunity. Often enough qualifications without the opportunity have little chance. It is the gradual retirement of the leader that gives the younger men the opening for proving their fitness to become efficient successors in maintaining a well-conducted and prosperous concern. One finds it hard to have either sympathy or admiration for the man who protests that he cannot leave his business for a holiday, or for a home or export trade tour. Sooner or later a business so conducted, with no "second" to step into the breach when occasion requires, must inevitably suffer. We are not thinking of small firms that are in their early stages when, of course, constant and consistent attention must be given, just as Deutsche in Germany and others in this country gave it before their concerns really grew up; for such, the question has a modified application. But in bigger concerns, of course if the question of financial control is not a deciding factor, there should, as a rule, be one or more men upon whom the cloak of a strong chairman or leading director could fittingly fall in case of natural emergency.

Speaking generally, we regard it as a mark of efficient organisation if a business can be left; if the chiefs need not always be at everybody's beck and call. It used to be complained by critics of a generation or two ago, that some of our famous industrial concerns would go to the dogs because fathers' sons were following the hounds after presenting themselves for a few moments at the works first thing, but sometimes experience proved that whatever the intention might have been, the actual effect was to afford good men an opportunity for efficiently filling posts of authority.

Much has been said against the bringing-in of outsiders who are considered superior because they have a well-advertised record as business-men in other kinds of trade possessing little similarity to electrical commercial transactions. Only in respect of the application of broad general policy, can such bees pass efficiently from flower to flower in the industrial garden, making money and incidentally gathering it.

It will be obvious that much more might be written on such a subject, but the main consideration following upon the German company's experience is that the selection of efficient men who can be fully trusted, and who are armed with and permitted to use authority, is one of the prime essentials of a successful undertaking. It is a really big part of the whole scheme of business organisation, it is not limited to heads, but must be applied in departments so that continuity and smooth running in each section may be possible whatever happens.

The Trend of Electricity Supply.

THE technical proceedings in connection with the Convention of the Incorporated Municipal Electrical Association and the Engineering Conference contained much matter of special interest, in view of its bearing upon the problems which are now confronting the electricity supply engineer and the trend of current practice in the distribution of electricity. The industry concerned is actually passing through a phase of profound significance—a veritable revolution in fact, though on the surface this may not be readily apparent. On the one hand, the system of generation is being radically reconstituted—that, certainly, is sufficiently obvious; on the other hand, the distribution system also is on the threshold of great changes, which necessarily must be carried out gradually and will not be spectacular, but none the less are fundamental in character and scope.

The influences at work in the case of the latter are many and various. Without pretending to exhaust the list, we may cite a few of them. First, the declarations of successive Governments that they would take steps to develop the use of electricity, culminating in positive action on the part of the present Government, have intensely stimulated public interest in the subject and produced in the popular mind the impression that the electrical age is about to be realised; the fact that the national scheme does nothing at all to promote the distribution of electricity is immaterial—it is recognised that

authorised undertakers must tackle this problem themselves, and they are in fact already preparing for the struggle. Next we may take the growing demand for electricity emanating from the hitherto inarticulate and perhaps heedless rural residents, who in the past saw no hope of getting a supply and accepted the inevitable with resignation, but have been aroused by political promises and prophecies to a perception of their rights. Again, the town dweller is discovering that electricity, after all, is not merely an expensive luxury, but is becoming a necessity, and that it can greatly improve the conditions of living in the household—moreover, the supply engineer, finding the development of the power load difficult in a time of depression in industry, is turning his attention to the promotion of domestic electrification and is fostering the new spirit that he finds in the attitude of the public towards electricity. Another factor, of great but unforeseen importance, is the mode of charging for electricity that is laid down in the Act of 1926, which embodies a maximum demand and a unit charge, and incidentally has compelled the (future) purchaser of bulk supply to take thought for the reduction of the peak load and the increase of the output of energy off the peak—as Lt.-Col. Vignoles so effectively puts it, they will pay for kilowatts, and must use those kilowatts over and over during the twenty-four hours. We wish to emphasise the importance of this new influence—new in form, that is, but not in essence, for it is the same principle that we have preached for years, namely, *increase the output of energy per pound sterling of capital expended and per kilowatt of plant installed.* Hitherto the engineer has been apt to strive for reduction of costs primarily in his own power station; he must now realise, in face of the Central Electricity Board's tariff, that the cheapening must be made by spreading the fixed charges over a larger number of kilowatt-hours for a given maximum demand.

These and other considerations are going to affect the density and distribution of the demand so much that methods of distributing electricity will also be profoundly influenced, and already we have Mr. L. Romero talking of heavy mains, an intermediate (*i.e.*, a higher) distributing pressure, and the multiplication of transforming points; d.c. distribution in populous centres will become almost impossible, and conversion to a.c. will be accelerated in order to cope with the load.

The imperative necessity of filling up the valleys in the load curve has turned the thoughts of station men to electric cookers, fires, and water heaters as never before; the last-named outlet for off-peak energy, in particular, to which we have devoted so many articles during the past two years, has at last been recognised as a most hopeful and profitable one, and at these recent conferences, as well as at the electrical exhibition at Bath, it has received the attention that it certainly merits. The two-rate tariff is firmly established as indispensable to the successful development of the right sort of load.

Much more could be said, if space permitted, in support of our thesis that distribution is about to undergo extensive changes, both commercial and technical.

"No Circulars, No Hawkers."

WHILE we have every sympathy with electrical contractors, dealers and electricity supply authorities who are using ingenuity in pushing the sales of electrical apparatus, we wish to utter a note of warning against the danger of adopting measures which threaten to bring electricity into ridicule by house-to-house campaigns which may become, if they have not already done so, a public nuisance. It is the duty of every electricity supply undertaking to bring its commodity under the notice of every resident in its area and to do so in the best possible way. There are methods for so doing which are suited up to a point to all districts, but it is fairly commonly accepted that while centrally adopted organisation with its literature and campaign advertising material is extremely useful practically everywhere, there are local variations which local knowledge dictates. But these, speaking generally, are legitimate and helpful, through the post, in the Press, on local hoardings, by local co-operative exhibitions, and so forth, and the public interest when aroused by such means is likely to bring good to the industry. It is the stream of house-to-house callers who, one after the other, persist in bothering householders at awkward times and with unconscionable volubility with offers of demonstrations of this or that device, which is always cheaper and better than any other, and most frequently seems to be of foreign origin, that is calculated to arouse annoyance rather than interest. It is the fruit of the policy of producers or importers who elect to go direct to the public instead of making such terms with the trade as shall make it worth their while to handle the goods in an effective way. We are out for cheaper electrical apparatus as one means for accelerating the rate of domestic electrification, and we sympathise with the army of men who are driven to earn some sort of a livelihood by this particular brand of salesmanship, but we do not think that the electrical trade will permanently prosper by making itself a nuisance.. We are not discussing at the moment whether manufacturers should or should not deal direct with the public—that subject has been well ventilated; but manufacturers of repute who favour an independent attitude in that matter are seldom likely to commit the error of making themselves unpopular by employing methods which place their employés on the same level as the importunate hawker of buttons and needles or packets of lavender.

Co-operation in Engineering Works.

ONE of the latest examples of the practical application of the co-operative principle in connection with the engineering industry is described in an interesting letter appearing in *The Times* last week from the pen of Mr. W. T. Bell, chairman and managing director of Messrs. Robey and Co., Ltd., of Lincoln. When it was decided to make this effort, each works department was invited to send a representative to meet the writer, some of the directors and the works management, round the same table. Every department sent its representative, and it was agreed unanimously to set up a body including 22 workmen elected by their own department, one from each, together with directors and management representatives. A proposal to call the body a Works Committee having caused trouble with the trade unions, it was resolved to name it the R. B. C. or Robey's Board of Co-operation, and under that title it has been in existence for well over a year. Mr. Bell intimates that the mere coming together made it easy to clear up a number of complaints or grievances of the kind that shrink when reasonably laid open to the light of day, and at later meetings, held regularly once a month, the parties have worked together on a constructional basis. Helpful and sound ideas put forward by the workmen have in many cases been put into immediate effect, and interesting information as to the progress of the business has been imparted to all present by the chairman. In addition, a quarterly meeting has been held jointly with all the works foremen. At the end of the first year a constitution was evolved and its details were distributed throughout the works. This is printed in Mr. Bell's letter, and paragraph (2) reads:—

> "The objects of the R. B. C. shall be the making of suggestions with regard to, and the discussion of all matters relating to, workshop methods of production, progress of manufacture and improvement in interdepartmental relations, with a view to improved relations between the management and the men. The board (men's section) shall not assume the duties of shop stewards, or take any action likely to cause friction between the board and the trade societies."

The writer states that experience has proved that the workmen have a definite interest in the experiment, and the directors claim it to be a success.

Automatic Traction Sub-stations.

The following interesting account of the working of the automatic traction sub-stations which have been installed at Sheffield shows much improved conditions during the 12 months' operation of the new equipment.

(COMMUNICATED.)

IN 1926 the Sheffield Corporation Tramways and Motors Department decided to extend certain of its tramway routes, and it became necessary for the Electric Supply Department to reconsider the traction power supply at various points. The automatic rotary sub-station was chosen as the best means of dealing with the anticipated load, and, after inspecting various automatic sub-stations, an order was placed with the English Electric Co., Ltd., for a transformer and complete automatic rotary-convertor sub-station equipment capable of delivering 750 kW to the overhead line at Bawtry Road, Tinsley, at a pressure of 550/575 V. The set was to be level compounded, to work from the 11,400-C a.c. mains, and to come on load at a selected low voltage, but to cut-out if quarter load was not exceeded during a period of ten minutes.

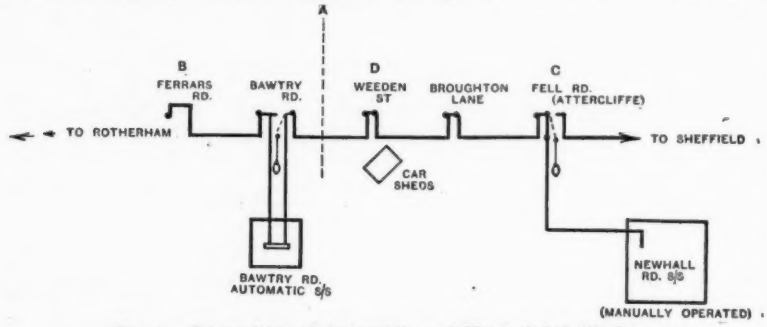


Fig. 1.—Disposition of Automatic and Manual Sub-Stations.

The sub-station is situated on the Sheffield to Rotherham route, two miles from the nearest manually operated sub-station. Fig. 1 shows the relative positions of various route points and the sub-stations; the major portion of the traffic is between Sheffield and Templeborough, with very heavy loads concentrated at points A and B. Prior to the installation of the automatic sub-station, increased traffic brought the voltage down very seriously at peak times. Fig. 2 is a voltage chart taken prior to the erection of the automatic sub-station, half a mile from point B. The automatic rotary sub-station was brought into daily service on April 8th, 1927, and it continues to function successfully. Figs. 3 and 4 show, respectively, the voltmeter and ammeter charts for June 9th, 1927. The steady voltage maintained while the automatic sub-station is in service is a great advantage; not only is a higher speed possible on the cars, but rush-hour traffic is got away very promptly. Another advantage, too often overlooked, is that the cars "answer" to the controller much more readily with a high and steady voltage, and so are able to slip through traffic, or to get away smartly after a block.

Referring again to fig. 1, and realising that the concentrated loads at A and B required at peak times 1,800 to 2,200 A transmitted from point C, the risk of interruption to the service owing to a failure of the interconnecting cables between points C and D had to be countered. Failure of either cables C or D would have transferred the work of transmission to the overhead line, necessitated the traffic being cut down to one third, and entailed so low a voltage as to reduce the service speed to a crawl; further, thousands of workmen would have been inconvenienced. Placing an automatic rotary sub-station at Bawtry Road has enabled a feed at high voltage to be given from each end of the route at a cost much below that of adequate feeder and return cables. It has also prevented any trouble arising from errant return currents seeking a direct and easy path to a distant sub-station.

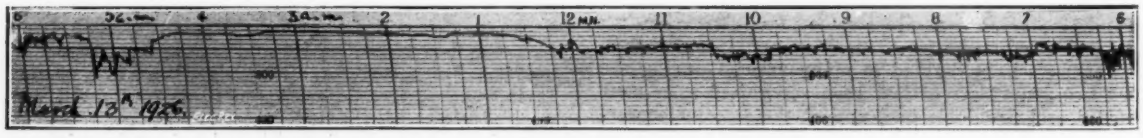


Fig. 2.—Voltage Chart (Bawtry Road), Manual Operation.

At A, fig. 3, the kick indicates the opening of a feeder circuit breaker due to a temporary "short" caused by faulty handling of a car controller. At that time the feeder circuit breakers were set to close after 30 seconds delay, and to lock out if after closing three times the "short" still remained on the line. This setting has been adjusted to a delay of 20 seconds on closing, with a lock-out after opening four times in succession. At point B, fig. 3, the dip in voltage marks the opening of the high-speed machine circuit breaker due to a very severe "short" of a temporary nature This high-speed breaker opens in 0.007 sec , and brings a load-limiting resistance into series with the negative lead of the machine. This process can be observed at point C, fig. 4, where the load curve drops to a steady low value for one or two minutes. The high-speed breaker closes after 1½ min. delay, cuts the limiting resistance out of circuit, and permits the machine to take up full-load

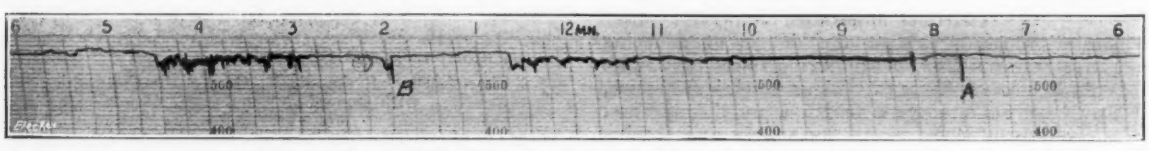


Fig. 3.—Voltage Record of Automatic Working at Bawtry Road.

again, provided the "short" has cleared; apparently, owing to the stoppage of this car, one or two other cars came to the same point, stopped, and then cleared away together, hence the brief interval on fig. 3 at B before quite normal voltage was restored.

Tramway extensions were also in progress on the Derbyshire border of the city, to meet which a two-machine automatic sub-station was installed at Cobnar Road, Woodseats. Each machine is of 750-kW capacity. There are four feeders and a selector gear which brings the second machine into service should the first machine be overloaded by 10 per cent. for five minutes, fail to start, or shut down for any reason. This station, like that at Bawtry Road, is a complete English Electric equipment. The voltage maintained previous to the installation of the Cobnar Road automatic sub-station is illustrated in fig. 5. This chart was taken at the Woodseats terminus. Since that date, June 2nd, 1926, a new park of considerable acreage has been presented to the city; this is at and beyond the Woodseats terminus. Fig. 6 shows the voltage drop on the occasion of the Park being opened by the donor, Alderman J. G. Graves. The supply came from a manually operated sub-station 2½ miles away, at which the bus-bar was maintained at 600 volts. The Tramway Department decided to run the line a mile beyond the Woodseats terminus up an exceedingly stiff gradient, and also to link the old terminus with that at Millhouses, rather more than two miles away, *via* Abbey Lane. The Cobnar Road double machine sub-station was put down to meet this increased load and to accelerate the existing service. Fig. 7 shows the voltage maintained by the automatic sub-station with the extension route included.

Interesting points on this very steady chart may be noted at *a* and *b*. At *a* a low voltage has been reached, but has not been maintained for more than a few seconds; the pressure rising before the time delay on the oil switch relay has been completed, the signal to start is cancelled. At *b*, however, the low pressure persists for longer than the 60 seconds time delay, and the station is brought into service. Both the time delay and the low-voltage point at which the signal to start is given are adjustable over a wide range. Another valuable feature of the Cobnar Road sub-station is its stand-by capacity to the south-west side of the traffic area.

On February 10th last a third automatic rotary sub-station supplying four feeders was put into service at Prince of Wales Road, Darnall. This station supplies a new route two miles long and assists the routes at the top and bottom of the new line. It is interesting to note that this tramway has taken the place of a motor-'bus service.

When considering the installation of an automatic sub-station, two points should be borne in mind beyond that of the normal all-day load. These are, firstly, the fact that rush-hour traffic is likely to call for loads of up to 30 per cent. or 40 per cent. overload for ten to twenty minutes on end, and secondly, that in the event

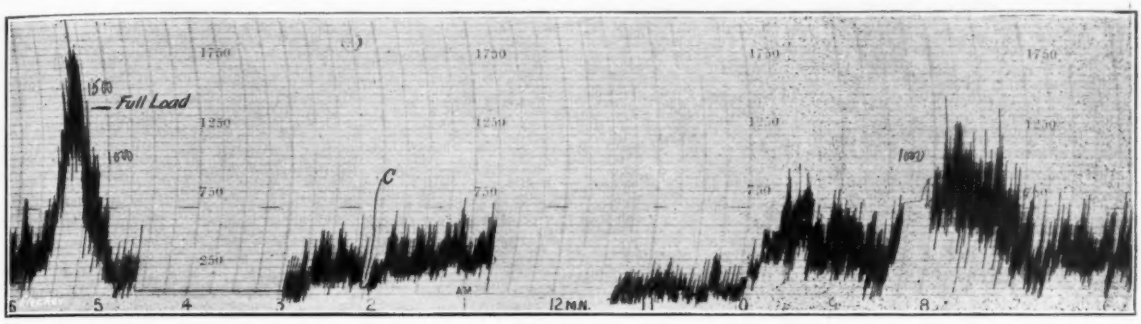


Fig. 4.—Load Curves from Bawtry Road Automatic Sub-Station.

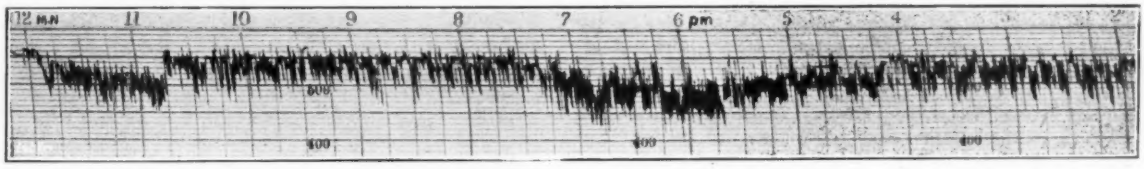


Fig. 5.—Manual Voltage Chart, Woodseats.

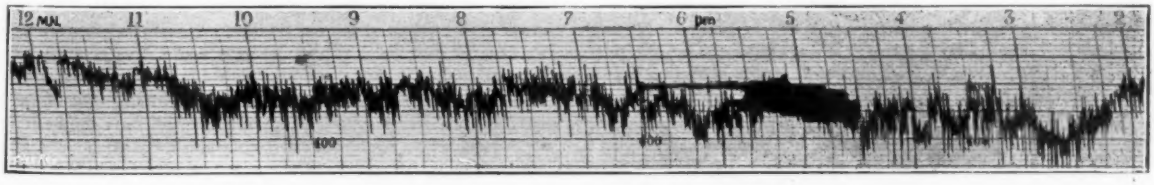


Fig. 6.—Woodseats Voltage (Manual) during Special Function.

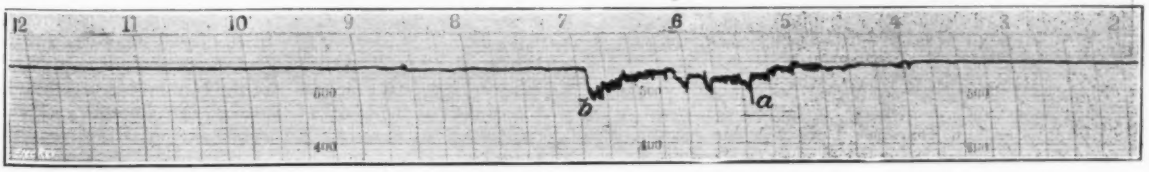


Fig. 7.—Voltage Curve at Woodseats "Sub," after Extension.

of necessary overhaul or trouble with a machine at a distant sub-station or on the connecting feeders, the automatic sub-station should be able to carry its own and part of the other sub-stations' loads and maintain a good voltage. Good voltage on a traction system means

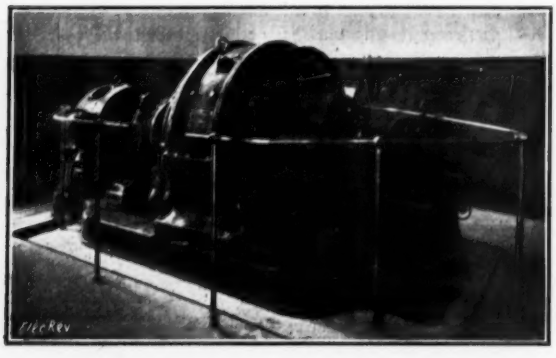


Fig. 8.—750-kW Automatic Rotary Convertor.

prompt and rapid service, and enables the tramway to compete with the motor-'bus; it entails automatic sub-stations at frequent intervals feeding the system through short lengths of cable.

Other advantages which have ensued from the use of the automatic sub-station are: reduced amount of attendance necessary in the manually operated sub-stations, in addition to the saving of six regular shift attendants and one spare attendant to bring the working hours within the 48-hour week. This in itself constitutes a saving of £1,260 a year, taking the cost of each attendant at an average of only £180 per annum.

Over and above this a very considerable saving in copper is possible, as the automatic station can be placed close to its work, thus cutting out the necessity for long lengths of feeder cable. It does not, in fact, pay to equip an automatic plant for many feeders. The best plan is to put down one sub-station at one end of a two-mile road and another similar plant at the other. This saves copper, maintains a better voltage all over the line, and enables the two sub-stations to be fed from separate e.h.p. supplies, and so increases the safety of supply. In most cases a single-unit station is advisable, except where very heavy concentrated loads have to be dealt with, when two machines may be installed in one

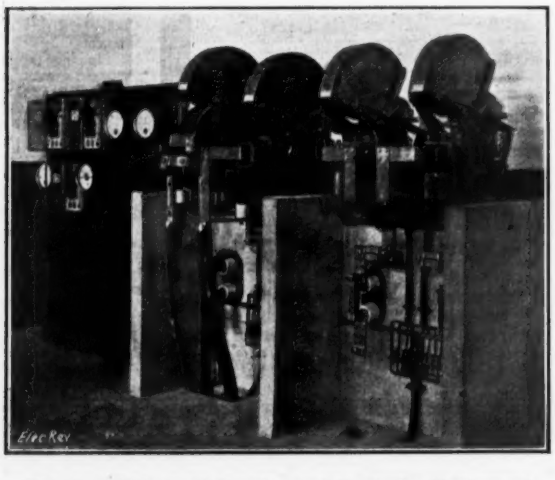


Fig. 9.—High-speed Breaker and Contactor Equipment.

building; for most tramway purposes, however, single-machine scattered sub-stations are to be preferred.

The design of the English Electric automatic sub-station follows a distinct line of its own. Its essential features are:—

(*a*) a separate exciter on the rotor shaft;

(*b*) a cam shaft controller actuated from the exciter circuit; and

(*c*) what is known as No. 1 circuit, which is taken through every protective device; unless this circuit is complete, the oil switch on the incoming a.c. feeder cannot close and the sub-station is kept dead.

All functions which require a variable period, such as the impulse to come into service or to shut down, are relay operated and controlled; energising the rotary field, cutting out in turn each half of the pony motor stator winding, and similar functions not requiring variable time control are carried out mechanically by the cam-shaft controller at definite time intervals. No. 1 protective circuit being complete, then on the line pressure dropping to 520 volts the line voltage relay makes the circuit to the oil switch closing relay. Should the low line pressure persist for a longer period than the time delay, say, 1¼ minutes, the oil switch closes and starting goes straight through. The l.p. side of the transformer is in circuit with the rotary through the stator winding of the pony motor; the exciter on the commutator end of the shaft has *its* field rheostat set at a definite point and works at 220 volts. The oil switch closing, the set runs up; on the exciter attaining 80 per cent. of its voltage, and after a short time delay, the

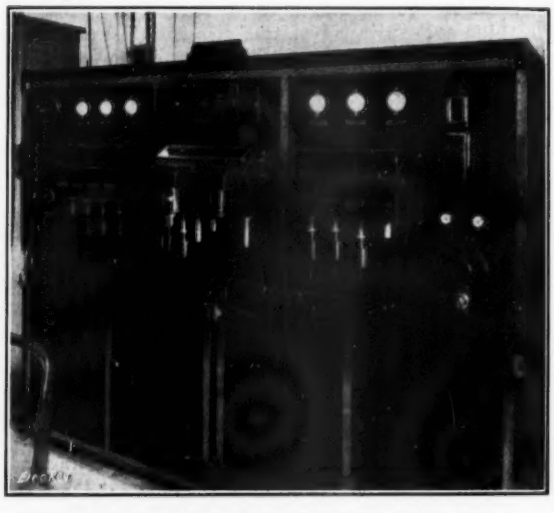


Fig. 10.—Control Cabinet at Bawtry Road.

cam shaft operating motor is brought into service and starts to rotate the controller. Half the pony-motor stator winding is cut out, and after a delay of two seconds the rotary convertor field is made across the armature terminals, and the discharge resistance through which it has been connected till this moment is cut out. Making the rotary-convertor field across the exciter terminals brings the machine into synchronism, and the cam shaft motor comes to rest after making a circuit from the exciter to one coil of the synchronising delay relay and another to a second coil which is across the d.c. terminals of the convertor. A further relay is connected across the line and the exciter. In the event of wrong polarity, this relay operates and prevents the completion of the starting sequence, resulting in the station being locked out through the operation of the total time relay. If, however, the polarity is correct, the synchronising delay relay operates, and again makes the circuit from the exciter to the cam motor.

The controller rotates again and carries out the following operations:—The stator winding of the pony motor is open circuited: the speed of the cam motor is reduced; the convertor field is made through the rheostat and permanent main running contacts; the circuit from the potential transformer (No. 1 protective circuit) to the no-volt coil on the d.c. panel is made, and this pulls up the plunger of the relay for closing the machine contactor; the controller shaft then brings itself and the cam motor to rest by opening contacts on the position regulator. The machine is now connected to the d.c. bus-bars trough the current limiter; after the determined

time delay, the high-speed circuit breaker closes and allows the rotary to take the full load available.

It is of interest to note that on a run-up for a demand of 500 amperes the load on the machine is kept down to 200 amperes during the time delay whilst the machine is

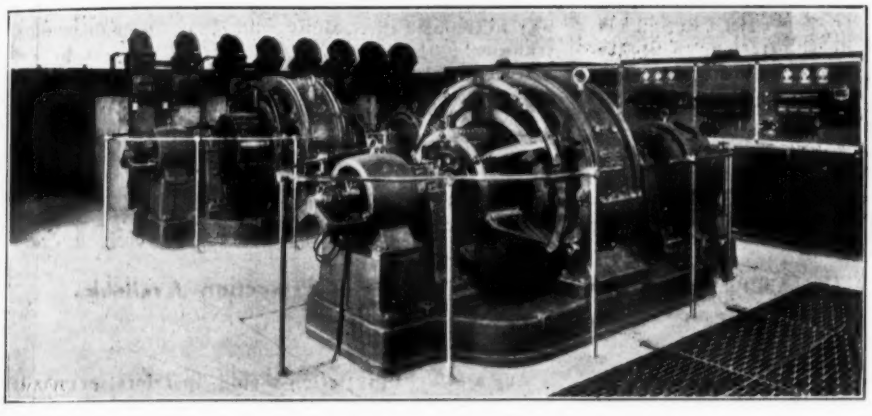


Fig. 11.—Interior of Cobnar Road Sub-Station.

supplying through the limiter. Shutting down occurs through the underload relay signalling to the underload timing device to come into action. The time delay having been run through, this device breaks No. 1 protective circuit, trips the machine positive contactor, opens the circuit on the hold-on coil of the high-speed circuit breaker, and almost instantly trips the oil switch.

The tripping of the oil switch again completes the circuit to the cam-motor relay from the exciter, starting the controller on its journey back to the re-start position. The controller puts the convertor field across the discharge resistance and then disconnects this field from the exciter. The speed of the cam-shaft motor is reduced, the main connections to the slip rings are broken, and the controller is brought to rest in the correct position for making a re-start. This position of the controller de-energises the cam-motor relay and stops the cam-shaft motor. The feeder contactors are closed through their relays wherever pressure is on the sub-station busbars. These contacts are set to open four times on heavy overload, with an interval of 20 seconds between each closing and a lock-out after the fourth opening.

Fig. 8 shows the 750-kW automatic rotary convertor in Bawtry Road sub-station. The starting motor is on the left and the exciter on the right at the commutator end of the machine. Fig. 9 is a view of the d.c. switchboard and instrument panels on the left, with the high-speed circuit breaker, the machine contactor, and two feeder contactors or circuit breakers. This view also shows the cubicles in which are housed the contactor gear, the isolating links and the leads of the multi-core cables which control the closing, opening and locking-out of the circuit breakers. These cubicles are situated near to the commutator end bearing of the rotary convertor. Fig. 10 is a front view of the control cabinet at Bawtry Road. At the top left-hand corner is the master control switch by means of which the sub-station as a whole is put to automatic or manual working. The relay which brings the sub-station into service on low voltage is immediately below this switch, whilst the low-load cut-out device occupies the top of the centre panel. The six lamps shown at the top of the left- and right-hand panels light up when for any reason the station has locked out. The lamp on the extreme left indicates that the set has shut down owing to the operation of the machine thermostat caused by heating of the windings due to overload long continued. The next two lamps indicate that trouble has occurred on the bearings at either the a.c. or the d.c. end, each bearing being protected by a thermostat. The left-hand lamp on the right-hand panel lights up if the cam-shaft controller interlock has acted and prevented the cam shaft completing the operations of starting, running up, or synchronising. This may be due to exciter or starting-motor failure, or failure on the cam-shaft motor; but whatever the cause, the oil switch is tripped and locked out until the fault has been attended to.

Once a start-up has commenced, then within two minutes the total time delay will function and lock the station out. This would then light up the next, or fifth, indication lamp, showing that some part of the protective group had come into action. The procedure is then as follows:—The glass-covered relay box on the middle panel immediately below the low-load cut-out device is inspected, when it can be observed that the relay marked

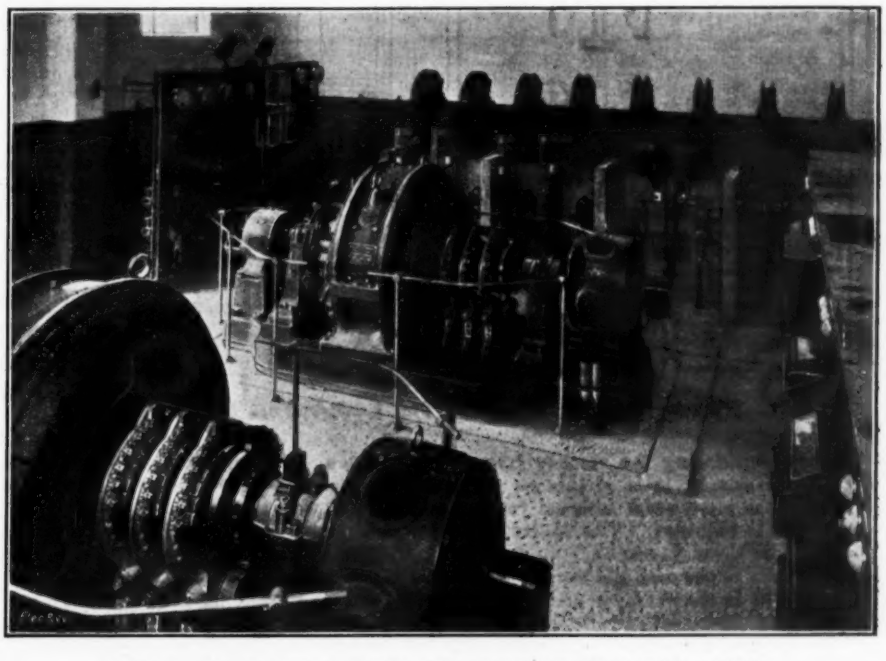


Fig. 12.—Another View of Cobnar Road "Sub," showing d.c. Cubicles.

"Total time" is displaying a red label or flag, showing that it has tripped; when closed, the relay displays a white label. Fault location is thus very promptly ascertained—a most valuable feature. The sixth lamp

indicates that the overspeed device in the rotary-convertor shaft has acted. At the extreme right of the control cabinet the thermostat for the machine is situated, whilst just below comes the switch for regulating the point at which low d.c. voltage will start to bring the station into service. The tumbler switch is used to bring the set into service for a trial run up after cleaning or overhaul. Fig. 11 shows the two 750-kW sets installed at Cobnar Road sub-station, with the grating covering the transformers in the foreground, the control cabinets behind the a.c. end of the rotaries, and the d.c. machine and feeder circuit breakers behind the second machine on the left. Fig. 12 is a view taken from above the transformer grating and shows the second machine, the d.c. cubicles, and the d.c. switchboard and instrument panels on the left.

The automatic sub-station enables the electric tramway to compete successfully with other forms of modern transport; the type adopted in Sheffield has proved extremely reliable and very economical.

Protection of Power Transformers.

An Examination of the Comparative Merits of the Systems of Protection Available.

By G. L. E. METZ and S. B. WARDER.

THE power transformer, being a static piece of apparatus, is particularly immune from internal faults; when such faults do occur, however, it is invariably put out of commission for several months for repair. The provision, therefore, of some form of protection which will isolate the transformer in the incipient stages of the fault, limit the damage resulting, and shorten the time that it is out of commission, is not only justifiable, but under certain circumstances a financial necessity.

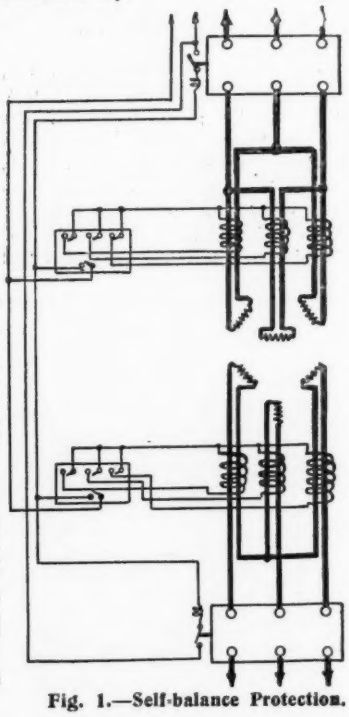


Fig. 1.—Self-balance Protection.

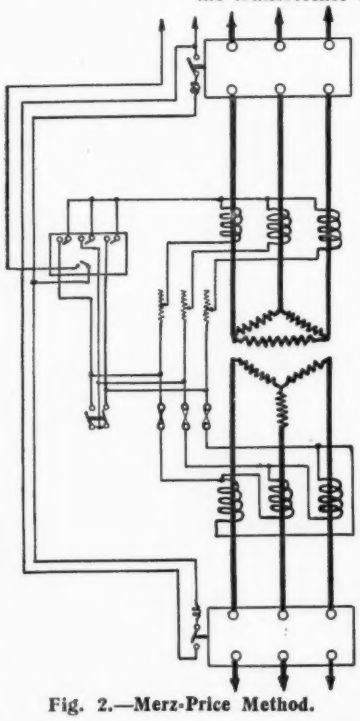


Fig. 2.—Merz-Price Method.

Before considering the various forms of protection that are available, it is of interest to investigate the origin of the most usual internal faults against which protection is required. The faults met with can be divided into three classes:—

(1) Faults in the core and magnetic circuit.
(2) Faults in the windings and electric circuit.
(3) Faults in the oil and dielectric circuit.

The study of the records of transformer breakdowns which have occurred over a period of years* shows that between 70 per cent. and 80 per cent. of the failures that do occur can be finally traced to short-circuits between turns, or between layers in the sections of which the high-pressure winding is composed.

* S. A. Stigant, "Power Transformers."

Any system of protection should, therefore, primarily concentrate upon this particular source of breakdown, as 80 per cent. of the recorded breakdowns of transformers could thereby be eliminated. In addition, it must cover the other faults to which power transformers are subject, the most common being short-circuits between phases, earth faults, and the breakdown of core bolts.

The protective gear required, in addition to isolating the transformer immediately upon the occurrence of an internal fault, must be absolutely unaffected by disturbances which may occur outside the zone of protection, otherwise the power transformer is liable to be disconnected at a time when it is most important that it should remain in circuit.

The requirements demand, therefore, that the system of protection adopted must be:—

(1) Sensitive, to operate in the early stages of the fault, and reduce the damage to the transformer to a minimum.

(2) Stable and discriminative, to be unaffected by disturbances which occur outside the zone of protection.

Considering the systems available for adoption at the present time, they may be divided into two classes:—

(1) Differential and balanced systems, such as Merz-Price, Self-balance, McColl, Fitzgerald, Core-balance, Wegener, Asea, &c.

(2) Chemical systems, such as Buchholz.

The general principle of operation of these systems, together with a consideration of the individual characteristics of each, is given below, from which it is possible to compare the various advantages and disadvantages, and enable the final choice to be made upon a fair basis of comparison.

Differential and Balanced Systems.

These systems of protection depend for their operation upon one or both of the facts given below:—

(1) The current entering the primary or secondary winding of a healthy power transformer should be exactly balanced by the current leaving it.

(2) The currents flowing in the primary and secondary windings of a healthy power transformer, under steady conditions of load, bear a definite and constant ratio to one another.

A description of typical systems of protection that come into this category follows.

Self-Balance System of Protection.*

This system of protection is shown diagrammatically in fig. 1, from which it can be seen that it depends for its operation upon the balance of currents entering and leaving the transformer winding.

A current transformer is provided for each winding of the transformer to be protected, which is slipped over the incoming and outgoing leads to the power transformer winding. The secondary winding of the current transformer is connected to the oil-switch tripping relay. Under normal conditions, the currents entering and leaving the power transformer winding will be equal, but in opposite directions, and no flux is produced in the current-transformer core.

When a fault occurs in the transformer winding which is protected, all the current entering the windings of the power transformer does not return through the end connection, part of it taking a short path through the fault.

The primary currents of the current transformer no longer balance and neutralise one another, and the resultant produces a flux in the current-transformer core which excites the secondary winding and operates the tripping relay. Since the current transformers are inherently balanced, this system of protection enables very sensitive settings to be made without sacrificing stability, and there is no danger of operation under conditions of heavy overload due to unbalance in the current transformers themselves.

The balance is obtained between the currents entering and leaving each individual phase winding, and not between the currents in the primary and secondary windings; hence no danger of operation due to unbalance caused by transient switching phenomena is encountered.

The measure of protection provided by this system is indicated by Table I.

Merz-Price System.

This system operates upon the principle of comparing the primary and secondary currents which flow in the windings of the power transformer, and is shown diagrammatically in fig. 2.

A current transformer is connected in each phase on the primary and secondary sides of the power transformer, and each set is connected by means of pilot wires as shown. At equipotential points of the interconnecting pilot wires, the oil-switch tripping relay is connected.

The ratio of the current transformers on the primary and secondary sides varies in proportion to the ratio of transformation of the power transformer to be protected.

Under normal working conditions, when no fault has occurred in the power transformer windings, the currents flowing in the primaries of the two sets of current transformers are in proportion to the ratio of transformation of the power transformer, and therefore the same current flows in the secondary winding of each current transformer.

Under these conditions each current transformer contributes equally to the current flowing in the pilots and the relay, which, being connected at points of equipotential, does not operate.

When a fault occurs in one phase the ratio of primary and secondary currents is upset, and the current transformers no longer contribute equally to the currents flowing in the pilot wires. The points at which the relay is connected are no longer at equipotential, with the result that the relay operates, tripping the oil switch.

It is important that the current transformers used on the primary and secondary sides of the power transformer should be very carefully balanced, both as regards ratio and phase-angle errors, for all conditions of normal load and overload, so that when a heavy current traverses the power transformer due to a short-circuit on the system outside the protected zone, the current transformers maintain their balance.

In a transformer a certain amount of current is taken on the primary side by internal losses which have no component to balance them on the secondary side. Under normal conditions, whether the transformer is on load or not, the only effect this will have on the protective gear is to limit the sensitivity which may be obtained. At the moment of switching-in, however, a very heavy current may be taken momentarily which dies down more or less slowly, and often causes sufficient unbalance to operate the protective gear and prevent the transformer from being put into service at all.

It is usual to get over this trouble either by using charging resistances in the oil switch, by disconnecting the protective gear when switching-in, or by shunting the relay by means of time-limit fuses, which introduces an inverse time delay in operation. None of these methods is ideal, and the last has the very serious disadvantage that it robs the protective gear of its most valuable property, namely, its instantaneous and sensitive operation.

With power transformers having a high ratio it is found practically impossible to make the protective current transformers upon both the high-voltage and low-voltage sides of the same type.

Table I.—Comparative Measure of Protection Afforded.

System.	Sensitivity.	Discrimination.	80 % of Total Fault.	20 % of Total Transformer Faults.		
			Faults between turns.	Short Circuits between Phases.	Earth Faults.	Broken down Core bolts.
Core Balance	5 %	Good	No	No	Yes	No
Self Balance	5-10 %	,,	,,	Yes	,,	,,
Merz Price	50 %-100 %	Indifferent	,,	,,	,,	,,
McColl	10 %-20 %	Good	,,	,,	,,	,,
FitzGerald	10 %-20 %	,,	,,	,,	,,	,,
Wegener / Asea	10 %-20 %	,,	Yes	,,	,,	,,
Buchholz	Under 5 %	Very Good	,,	,,	,,	Yes

The essential for a stable system of protection of this type is perfect balance of the current transformers under all conditions of load and overload. This is impossible to obtain unless the current transformers that are balanced against one another have exactly the same shape of core, disposition of windings, and ampere-turns, a condition which it is not possible to fulfil upon current transformers of widely differing pressure and current capacity.

Unbalance, unless high fault settings are used, is therefore inevitable, and the protective gear will cause serious inconvenience by disconnecting the transformer from the line when it is quite healthy, but when faults and disturbances are taking place outside on the system.

This sacrifice of sensitivity cuts right across the purpose of protective gear, and prevents the transformer from being disconnected in the early stages of the fault before the damage is severe. The difficulty has, however, been overcome by the use of biased protective systems, such as those made under the McColl and Fitzgerald patents.

The McColl system embodies this biasing characteristic in the relay, which has two windings, one an operating coil wound for operation from the difference current flowing through the pilots, and the other a restraining coil which is connected in series with the pilots and carries the main circulating current.

The restraining effect of this coil will clearly be proportional to the value of the circulating current in the pilot wires. In the event of the passage of heavy through-currents occasioned by a fault outside the protective zone, the pilot-wire current will obviously be high, and the restraining force preventing the operation of the relay correspondingly large.

By this means it is possible to obtain stability together with sensitivity, without even the use of specially balanced current transformers, which is a very great advantage.

* Hilton Higgs, "Protective Systems."

Difficulties are met with on the systems of protection described above, when they are fitted to power transformers supplied with taps, more especially when they are arranged for tap changing on load.

As similar taps and facilities for changing have to be provided upon the protective current transformers, or recourse has to be had to still higher fault settings of the protective relay, to cover the out-of-balance caused by changing from one tap to another, and altering the ratio of transformation of the power transformer, this has been overcome by the system of protection described below.

Wegener Asea System.

This form of transformer protection is only applicable to transformers having a delta winding. Its chief advantage lies in the fact that no protective current transformers are required on the star-connected side, which is usually the high-pressure side.

It operates upon the principle that the vector sum of the currents in the three phases of the delta winding is always zero, when the neutral of the star-connected winding is unearthed, and equal to the current in the neutral point when it is earthed.

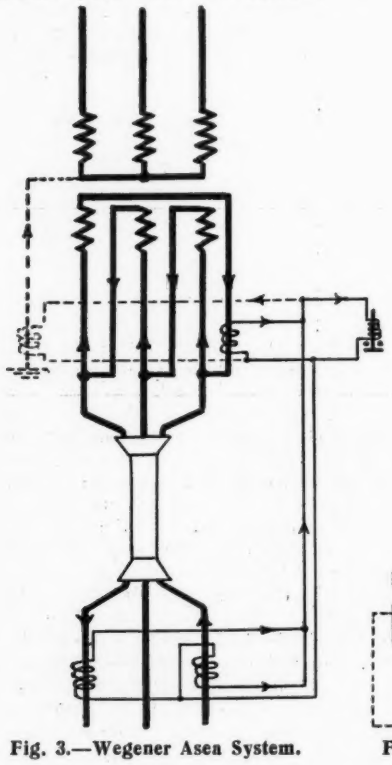


Fig. 3.—Wegener Asea System.

From the diagram of connections given in fig. 3, it can be seen that the resultant current, should a fault occur between turns or layers on the star- or delta-connected windings will pass through the protective relay, tripping the oil circuit breaker.

A current transformer is connected to the neutral point of the star-connected winding, if the latter is earthed, to prevent operation due to earth faults outside the protected zone.

This system of protection has the advantage of cheapness and simplicity. It is fitted with the biased type of relay for stabilising purposes, and overcomes the tap changing problem very efficiently. (It will not give protection to earth, however, unless current transformers are provided on the star winding.)

The measure of protection provided by the above forms of protection is indicated by Table I, from which it can be seen that not one of the systems considered is capable of operating upon the occurrence of a fault between turns or between layers; neither does any of them operate upon the breakdown of core bolts. As these faults are responsible for at least 80 or 85 per cent. of the breakdowns that occur in practice, if the above systems of protection are 100 per cent. efficient, and operate for every other kind of fault (which is doubtful), they only protect against 15 per cent. of the breakdowns that occur.

Of course, faults between turns, or between layers on a section, eventually lead to earth faults or a short circuit between phases, so these systems do eventually operate, but only after the fault has existed for, it may be, several hours, days, or even weeks, and the damage due to burning is extensive.

It can be seen, therefore, that the existing forms of protection, satisfactory as they may be up to a point, do not cope with the real and most common type of breakdown against which protection is so urgently required. If some such system could be discovered, it would not only save hundreds of pounds in the cost of repair, but would also limit the time during which the transformer was out of commission.

Both of these are factors of such great importance that they cannot be overlooked. Such a system of protection is to be found in the comparatively new Buchholz gear.

The fundamental principle of Buchholz protection is founded on the knowledge that, without exception, all internal faults in a transformer cause local heating, which results in the generation of gases due to the change of state of the affected part.

The quantity and character of these gases enable the severity and possible origin of the faults to be decided, and they are collected and used to operate alarm devices, and also to trip the oil breaker when necessary.

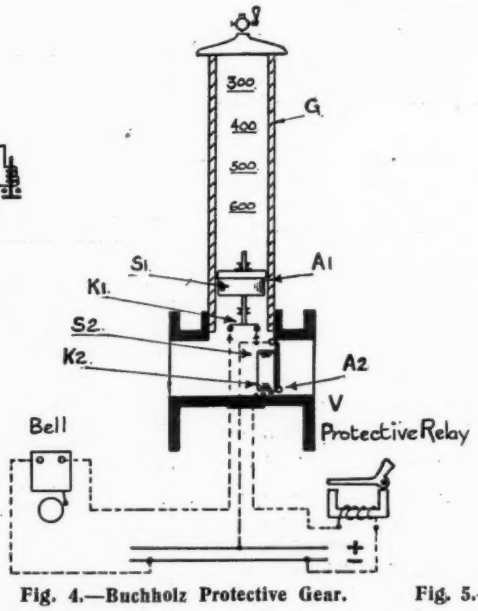


Fig. 4.—Buchholz Protective Gear.

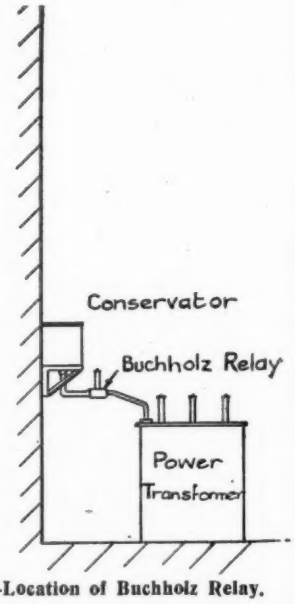


Fig. 5.—Location of Buchholz Relay.

The protective gear consists of a valve v (fig. 4), a graduated glass pipe G capable of being closed at the top, and two cylindrical floats S_1 and S_2, with contact devices K_1 and K_2. The float S_1, set perpendicularly in the glass pipe, with stop A_1, serves to give the alarm. The float S_2 is allowed to oscillate in the metal chamber v, with a stop A_2 that serves to shut down in cases of danger.

This apparatus is connected between the transformer and conservator as shown in fig. 5; the glass pipe is filled with oil for normal operation, and floats S_1 and S_2, on account of their buoyancy, take up positions against the stops A_1 and A_2, the contacts K_1 and K_2 being opened in consequence.

If gas bubbles, due to any small disturbance, occur in the transformer, they rise through the connecting pipe between the transformer and the conservator, and take up a position round float S_1. The buoyancy is, therefore, decreased, and the float falls, closes the alarm

circuit, and allows gases to escape into the other portions of the glass pipe, then returns to its position against stop A_1, and resets itself.

In the event of dangerous faults in the transformer giving rise to the sudden formation of large volumes of gases, float S_2 is brought in a series of jerks to the opening by the pressure waves propagated in all directions in the oil, and contact K_2 operates, closing the trip coil circuit.

The intimate workings of this relay are not of prime importance to general engineers, but the great advantage of this system of protection, shown in Table I, results from the fact that the apparatus is actuated by a condition that only arises in the event of a fault, and which does not occur under any other conditions. For this reason, it is more stable than any other system of protection being absolutely unaffected by disturbances which occur outside the transformer, and hence its sensitivity of operation is not limited in any way by these considerations.

The somewhat novel principle upon which the operation of this system of protection depends is likely to cause engineers to be cautious in recommending its use, and in order to offset this very natural hesitation it is interesting to note that this system of protection has been installed, up to the end of last year, on approximately 10 million kVA of power transformers throughout the world.

The majority of these units are located in Central Europe, where it is becoming almost a general rule to install this system of protection with any transformers over 200 kVA capacity.

It is significant that on the Continent, insurance companies are prepared to allow a rebate on their tariffs for power transformers fitted with the Buchholz system of protection. This fact proves the financial wisdom of installing an efficient form of protective gear. In the case in point, the rebate on the average pays for the installation of the protective gear in three years.

In conclusion, it should be observed that these notes were not written with the intention of proving any one system to be better than another, but rather to assemble the operating characteristics of the most common forms of protection available for power transformers at the present time, for the purpose of comparison.

From a consideration of the particulars of each system given in Table I, it would appear that when complete protection of a large and important power transformer is required, overload and Buchholz protection should be used; for small and less important units, overload and leakage protection is quite sufficient.

Selected Station Accounts.

Some suggestions for the standardisation of procedure by selected undertakings under the national scheme.

By ACCOUNTANT.

THE second schedule of the Electricity (Supply) Act, 1926, lays down the rules for determining the cost of production of electricity at selected stations, and those authorities which are in the fortunate position of owning selected stations will require to review their accountancy methods and reconstruct their forms of annual accounts so as to comply with the requirements of the Central Electricity Board. Two forms of revenue accounts will undoubtedly have to be adopted, *viz*:—(*a*) an account showing the actual cost of production at the selected station (referred to as the Selected Station Account) and (*b*) an account showing the cost of energy supplied by the Board, together with the cost of distribution within the undertaking's statutory area, and any other charges not recoverable from the Central Board (referred to as the Distribution Account).

No serious difficulties present themselves at this stage, but it will probably be considered advisable by the owners of selected stations that their accounts shall be reconstructed and kept in the amended form during the current financial year, although supplies to the Board may not actually be furnished during that period, in order that the scheme may be tried out, and that the main principles adopted by the authority may not be at variance with the rules laid down. The author proposes to review briefly the various charges which, in his opinion, may legitimately be included in the cost of production at a selected station, in the hope that a standard procedure may be adopted by all undertakers. Dealing with the costs *seriatim*, the following suggestions are put forward:—

Sums Expended for Fuel, Oil, Water and Stores Consumed, for Salaries and Wages, and for Repairs and Maintenance.

Owing to the lack of standardisation in the form of accounts of the various authorities, it should be noted that, in cases where it is the practice of the undertaking to charge the salaries of its technical generating staff under the heading of administration and general charges, this procedure should not continue, and all salaries of engineers having direct relation to the generation of electricity should be included under the head of generation expenses. Should there be any plant used for distribution purposes in the selected station, *e.g.*, rotary convertors, &c., the cost of maintenance of this plant should not be included in the selected station accounts.

Rent, Rates and Taxes (other than Taxes on Profits) and Insurance.

The rent, rates, fire and boiler insurance charges applicable to the station only should be included, together with income tax under Schedule A. The insurance premiums for workmen's compensation will require to be calculated separately, based on the total salaries and wages paid during the period under review. Income tax under Schedule D is dealt with later.

Management and General Establishment Charges.

The amounts chargeable against the selected station account under the heading of health and unemployment insurance and superannuation contributions (if any) should present no difficulties. The schedule states that the proper proportion of management and general establishment charges attributable to the station may be included, and on this point there may be some diversity of opinion. Dealing with this item on broad lines, it would appear necessary to divide the expense of management under three heads, *viz*.:—

(*a*) Expenses directly attributable to the selected station.

(*b*) Expenses common to the selected station and to the rest of the undertaking.

(*c*) Expenses directly attributable to distribution, *e.g.*, the wages of meter readers, meter clerks, and so on.

The expenses under (*a*) will, of course, be charged direct to the selected station account, and this item should include a proportion of the salaries of the chief engineer and his deputy, technical assistant, and so on,

together with the salaries of the necessary clerical staff, *e.g.*, wages, invoice and cost clerks, typists, timekeepers, and the like, directly engaged on the selected station accounts. From the total expenses of management and general establishment charges (including printing and stationery), should now be deducted the items under (*a*) and (*c*), and the remainder divided between the selected station account and the distribution account in the ratio of the cost of salaries for the selected station to the total salaries account. Such items as subscriptions to a Joint Industrial Council or District Joint Board should, of course, be allocated according to the wages and salaries attributable to the selected station. Expenses in connection with loans should be dealt with on the basis of capital expenditure.

The items usually included under the heading of net revenue account call for little comment, with the exception of that dealing with Income Tax on profits. The schedule specifically states that taxes on profits must be excluded from the costs of production. It should, however, be pointed out that, in the case of a municipal undertaking, Income Tax must be paid on the amount of the sinking fund raised for the liquidation of debt, and, as large extensions of plant will be necessary in the case of most selected stations, it would seem only reasonable that the tax payable on the amount of income raised to cover sinking fund payments on the capital expenditure should be allowed as a legitimate charge in the selected station account.

Questions will undoubtedly arise as to the inclusion or otherwise of plant purchased out of revenue in the selected station account. Sec. (*e*) of the schedule provides for the inclusion of interest on money properly expended for capital purposes (whether defrayed out of capital or revenue) and section (*f*) provides that where expenditure is defrayed otherwise than by means of loans the allowance for depreciation shall be increased by such amount as the Electricity Commissioners think just. Where plant is transferred from other stations to the selected station, the costs of transfer and reconstruction being borne out of revenue, these charges should be included in the cost of production account for the selected station.

The amount appearing on the income side of the selected station account, as the amount due from the Central Board will, of course, be the total of the expenditure side of the account, *i.e.*, no profit or loss will be shown in the selected station account.

Turning now to the distribution account, *viz.*, that showing the revenue account of the undertaking as a whole, the first item on the expenditure side will be the cost of energy supplied by the Board, after adjustments for the cost of production according to load factor and power factor have been made in accordance with Sec. 7, sub-section 4, of the Act. The costs per unit sold of this item should be apportioned over this charge in the ratio of the various items appearing in the total cost of production of the selected station account.

Where the authority is also the owner of other generating stations, containing plant of a less economical rating than that contained in the selected station, which have not been included in the scheme for selected stations by the Board, it is assumed that the whole of the expenses of running and maintaining these stations, together with the service of debt charges, will be included in the distribution account. The higher costs of generation in these old stations will have to be met by consumers within the authority's own area of supply, and it would appear, therefore, sound business policy to consider the closing down of these uneconomical stations as early as possible.

Finally, a point of some importance to Scottish undertakings is the accounting period. In general, in Scotland, the financial year ends at May 15th. No accounting period is mentioned in the Act, but it is assumed that this will end on March 31st, in line with English municipalities.

The Rating Relief Scheme.

Views of the Government's Proposals.

AT the informal monthly luncheon of the British Engineers' Association on June 14th, Mr. MICHAEL FARADAY, F.A.I., gave an address upon the Government's proposals for relieving industry of part of the burden of local rates. The President of the B.E.A., Mr. H. J. Ward, presided.

Mr. Faraday briefly reviewed the scope of the Rating and Valuation (Apportionment) Bill and said that the real issue was: Was it good or bad for industry that it should be subsidised in this manner? Some industrialists viewed any form of subsidy with alarm. In this instance the effect could only be to swell the dividends of prosperous trades while little was done for those industries which were "down and out." Depressed industries were already receiving a certain measure of relief by reason of the lower assessments that prevailed in their areas. On the other hand, in prosperous districts assessments were high and thus prosperous industries would enjoy a greater measure of relief. Leaders of the basic industries to whom he had spoken were convinced that the scheme was of little value and not worth the enormous administration costs which it involved. It had to be remembered that industrialists were also citizens. The money for this relief had to be found, and if they were relieved of rates they would have to provide the necessary funds by contributions to the national Exchequer. It was a fallacy to think that the relief would mean lower prices to the consumer, even in a prosperous industry. As an example he cited a typical brewery and showed that the effect so far as the consumer was concerned was infinitesimal. Mr. Churchill had stated that the relief to the coal industry would be equivalent to 9d. a ton. In fact the actual amount was nearer 2¼d. per ton; what difference would that make when the coalowners claimed to be losing from 1s. to 1s. 6d. per ton? If we could put the coal industry on its feet the beneficial effects would be felt by the whole of the basic industries. That could only be done if freights were lowered considerably; the reduction of transport charges was the solution of the whole problem. Taking it all round, the proposed measures of relief would be worthless. Already under the Rating of Machinery Act, machinery was to be exempt from rates, and only land and buildings were left. The manufacturers had to consider local interests, and he (the speaker) did not believe that they wanted to be relieved of their duty to their local areas. The "safeguarding" duties had led to the setting-up of factories in this country by foreigners (he referred particularly to the motor industry). Under this scheme these foreigners would be relieved of rates. He again emphasised the fact that rates were already low in the iron and steel industries, and therefore the benefit which they would obtain would be totally inadequate. Turning aside from the main subject, he pointed out that under the Rating of Machinery Act local authorities were not bound to give notice of the change in the methods of assessment, and therefore manufacturers should be on the alert to see that their assessments were reduced. In Westminster the assessment had only been reduced by £1 in each case, it apparently being the authority's intention to leave the manufacturer to contest the amount. In conclusion, Mr. Faraday said that if the manufacturers represented to Parliament that they desired to place the country first, believing that whatever benefited the country would benefit industry, the Bill would be thrown out.

The Chairman, having thanked the speaker, called upon those present to discuss the address.

Mr. W. REAVELL said that in these troublous times party politics must take a secondary place and all their attention must be devoted to the fostering of industry. He asked Mr. Faraday if he did not think that the secondary engineering industries would receive greater benefit if they gave up the proposed illusory relief and allowed the whole of the allotted amount to go straight to the relief of the basic industries. This, he thought, would reduce the cost of raw materials and lower freight rates. Was there not a way in which the total could be given to the coal and iron and steel trades and to the railway companies? The administration cost would be less and the benefit to the manufacturers greater.

Mr. S. H. HODGKIN said that during and after the war every original increase in price was multiplied on its way to the consumer. Would not a reduction of cost at the source have a similar cumulative effect?

Mr. Faraday replied that he did not think that that would be the case. With regard to Mr. Reavell's suggestion, he said that there was no doubt that if the 29 millions involved were given to the railway companies and they were compelled to pass it on in the form of lower charges the benefit would certainly be greater all round. Under the proposed scheme the railways would receive only £4,000,000. During the first 23 weeks of this year their loss on goods traffic amounted to £3,886,000. The relief would only just cover that loss and do no more. If they were given the whole amount there would be no administration costs and freight rates could be restored to pre-war levels.

Mr. Baldwin's Speech.

In the course of a speech at Edinburgh on Saturday last, the Prime Minister made reference to the Government's proposals. He pointed out that the effects of a depression in an

industry extended to the whole country. If, therefore, they could help any particular part of the country to bear its burdens they helped, to that extent, the rest of the country. They had attempted to reform the worst anomalies of the existing rating system and to do it in such a way as to bring the maximum help to those areas and industries which needed it most. They could not discriminate between prosperous and depressed industries. If, incidentally, they aided some businesses which did not need help they would encourage them to expand, and thereby diminish unemployment. The depressed basic exporting industries would receive relief to the extent of £14,250,000 of the £26,000,000 involved, while agriculture would account for £5,750,000. The relief amounted to 75 per cent.; had they attempted to spread it over the whole of the ratable property, only 15 per cent. could have been remitted. It was not claimed that the relief would restore the basic and exporting industries to their pre-war prosperity. The Government did claim, however, that the scheme was founded on a sound principle, that it would bring substantial relief, and that it would improve local administration.

The F.B.I.'s Opinion.

The Federation of British Industries has published a statement of its views on the Government's rating-relief proposals. The scheme is wholeheartedly welcomed, provided that the actual terms of the Rating and Valuation (Apportionment) Bill will actually carry out the intentions expressed by Ministers. The F.B.I. regrets that so much time will elapse before the scheme becomes effective, and it is suggested that if the relief were given to the railways at an earlier date it would have a beneficial effect. It is pointed out that the Chancellor of the Exchequer will have the necessary financial resources to enable this to be done. Some criticism is made of the drafting of the Bill, it being thought that the Government's intentions are not fully conveyed by the actual wording.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

Compensation for Displaced Employés.

Mr. KELLY has introduced a Bill to amend Section 16 of the Electricity (Supply) Act, 1919, to enable compensation to be paid to workmen of electrical undertakings deprived of their employment by regulation or otherwise after May 8th, 1919.

Electrical Trade Development.

On June 12th, Sir P. CUNLIFFE-LISTER, President of the Board of Trade, in the course of a review of the general trade situation, said that with regard to electrical manufacturing things were distinctly brighter. He found a very good record in the face of keen competition. Among the five great exporting countries of the world, Great Britain took the lead in the export of electrical machinery. That was a very remarkable thing, because, before the war, our position in this respect was not at the top. In 1927 we exported 31.4 per cent. of the total exports; Germany exported 30.4 per cent.; and the United States 29 per cent. He thought that that was very creditable. In the home market there had been some temporary falling off in orders, but in view of the great expansion which was indicated in the production figure, and as new schemes were sanctioned by the Electricity Commissioners, no doubt large orders would be forthcoming. He did not think they need be anxious about the volume of work which the electrical industry was likely to get.

With regard to trade as a whole, Sir P. Cunliffe-Lister gave many detailed figures for each industry, and said that, while there was some slackening at present, the figures showed a remarkable advance. The unhappy year 1926 was bound to cause a terrible setback, not only while it was taking place, but in the recovery from the aftermath. The advance that had been made in production in 1927 and the early months of 1928, in spite of 1926, was a very remarkable record. If our progress had been somewhat arrested, the more need was there for combined efforts and for mutual goodwill and understanding, so that success might be restored in the later months of the year.

Bournemouth Electricity Charges.

On June 12th Mr. A. ALEXANDER asked the Minister of Transport what steps he proposed to take with regard to any petitions and letters received from consumers of electricity in Bournemouth, Parkstone, and Poole asking for a reduction of the maximum charge for electricity in those districts.

Colonel ASHLEY said that certain representations had recently been received with regard to the prices charged for electricity by the Bournemouth and Poole Electricity Supply Co., Ltd. Those representations were being considered and, in the first instance, the Electricity Commissioners would communicate with the company on the subject.

Electric Traffic Regulators.

On June 12th Mr. DAY asked the Minister of Transport whether he had received any reports of the all-electric automatic traffic regulator that had been installed in Leeds and Edinburgh; whether his reports showed that that system of traffic regulation was successful; and whether it was intended to introduce similar systems in the London area.

Colonel ASHLEY said that the answer to the first part of the question was in the affirmative. The reports received indicated that a certain measure of success had been attained by the use of those automatic signals, but they were still in the experimental stage. The question of making experiments on similar lines in the Metropolitan area was already under consideration.

Legal.

Cancellation of an Apprentice's Indentures.

MR. JOSEPH PERKINS, electrical engineer, Marlborough Road, Plymouth, was sued at Plymouth County Court recently by Mr. Robert Sugden for the cancellation of his son's apprenticeship indentures and the return of a premium of £50. It was stated on plaintiff's behalf that defendant undertook to teach the youth the electrical engineering business "from A to Z." The lad was put on the work of wiring only, however, receiving no instruction in the other branches of the business. The apprentice, A. R. SUGDEN, said that for some time there had been no work of any kind, and he and the other apprentice had been told to go to the Free Library and wait there until called upon. Another former apprentice said that the only work done had been that of wiring.

Defendant informed the judge that he did well when he first started business, but owing to the action of an employé he had since found himself in a bad position. He was now agreeable to cancel the indentures. His Honour Judge Gurdon ordered the indentures to be cancelled and gave judgment for plaintiff for half of the premium paid, the defendant being allowed six months in which to return it.

Proposed Sub-Station in a Churchyard.

THE Judicial Committee of the Privy Council on June 12th heard an appeal from an order made by the Dean of Arches dismissing an appeal from an order made by the Chancellor of the London Consistory Court (*vide* ELEC. REV., February 3rd, p. 219). The matter arose out of the desire of the City of London Electric Lighting Co., Ltd., to enlarge a transformer chamber by extending into a disused churchyard. The London County Council opposed the agreement which had been made by the company with the church authorities, under the Disused Burial Grounds Act, 1884. The two lower Courts upheld the contention of the L.C.C. and refused to sanction the agreement. Their Lordships now intimated that they would consider the advice that they would tender to His Majesty.

British Thomson-Houston Co., Ltd., v. Light & Shade Co., Ltd.

IN default of defence, the British Thomson-Houston Co., Ltd., moved for an injunction, before Mr. Justice Romer in the Chancery Division on June 12th, restraining the Light and Shade Co., Ltd., 345, Edgware Road, W., from infringing its patents, Nos. 23,775 of 1912, and 10,918 of 1913, for improvements in evacuated vitreous containers having sealed-in conductors and for improvements in incandescent electric lamps.

His Lordship granted the injunction and also an inquiry as to damages, and an order for the delivery-up of any infringing lamps in the defendants' possession.

Marconi's Wireless Telegraph Co., Ltd., v. Adey's Wireless, Ltd.

ON June 15th, in the Chancery Division, Mr. Justice Romer heard a motion by Marconi's Wireless Telegraph Co., Ltd., for an injunction restraining the alleged infringement of their letters patent by Adey's Wireless, Ltd.

For the plaintiffs, Mr. TREVOR WATSON said there had been a purchase of a wireless set which, it was alleged, infringed the plaintiffs' patents. The defendants said that they made a wireless set for the purpose of testing it, and never intended to sell it until they got the necessary licences from the plaintiffs and the makers of the valves that were used.

Mr. RICHMOUNT (for the defendants) said the set was obtained by a trick. They experimented with a set and applied to the plaintiffs for a licence to sell sets of that description. On the day of the application a Mrs. James called on the defendants and asked if they had a wireless set. They said they had, but they could not sell it as they had not the necessary permission. She paid £5 as deposit and left. The next day a Mr. James called and asked for the set. The office boy, in the absence of a responsible person, and knowing nothing of the circumstances, handed over the set. The caller asked the boy to change the receipt into the name of "Mrs. James." Then, without anything further happening, the same day the

plaintiffs began these proceedings. The defendants never intended to make any further sets without the plaintiffs' licence or permission.

Mr. WATSON said that all these allegations were denied.

Replying to his Lordship, Mr. RICHMOUNT said he was willing to give an undertaking without prejudice on condition that the plaintiffs did not advertise it.

Mr. Watson undertook not to advertise it, and his LORDSHIP said that there would be no order on the motion, and the costs would be reserved.

Reviews.

Experimental Science for Technical Students. By R. W. HUTCHINSON, M.Sc. Pp. viii+277; 210 figs. London: University Tutorial Press, Ltd. Price 4s. 6d.

The author of this book, a "first course in experimental science," has written so many useful electrical works that the high quality of his productions is familiar to technical teachers, and the work of the printers and publishers is equally commendable. The book contains "those principles of science which are likely to awaken interest in the subjects, and which constitute an essential groundwork for the student's future work," whatever that may be; it is intended for first-year students in technical schools, and for pupils in secondary schools, and is based upon many years' teaching experience, which has led the author to omit some customary features and emphasise others. The scope of the work includes measurements in general, the principles of force and work, mechanical devices, heat, and electricity. It is interesting to note that the author makes early reference to the constitution of matter, briefly introducing the electronic theory. Much of the text is devoted to instructions for carrying out experiments, and to illustrative examples, and a set of test questions is appended. As an introductory textbook this appears to be admirably adapted to its purpose.

Principles of Mechanism. By F. DYSON, A.C.G.I., B.Sc. (Hons). Pp. viii+296; figs. 148. Oxford University Press. London: Humphrey Milford. Price 12s. net.

Among the subjects for which separate papers are set in the examination for the degree of Bachelor of Science in Engineering of the University of London as well as in those for the associate membership of the Institutions of Electrical, Civil, and Mechanical Engineers, is one entitled "Theory of Machines." Our experience is that the majority of students, to say nothing of engineers of more mature age, generally fight shy of this subject, preferring to take one or other of the alternative papers which are usually available. The reason for this is, no doubt, that the theory of machines is not as the name might imply, the theory underlying the design of those machines—alternators, steam turbines, pumps, just to mention two or three—with which the average engineer is called upon to deal, but is confined to that very limited class of machine which can also come under the term of mechanism. We do not wish to belittle the importance of this subject, although we feel that it is far from being the most valuable of those on which the examinations to which we have referred are based.

In the book under review, the author, while he has kept in view the requirements of the examinations in the "Theory of Machines," has endeavoured, as it were, to get behind this subject by dealing in a comprehensive manner with the fundamental principles which apply to the moving parts of machines. Hence, he reverts somewhat to the point of view adopted by the late Professor Dunkerley, who gave to his well-known book—a book which for many years was practically the only one on this subject—the simple title of "Mechanisms"; and has utilised the title "Principles of Mechanism," and it is, we think, one which more adequately describes the scope of the work. Again, while the subject matter of the book proceeds along conventional lines, being, as the author himself admits, written for students studying for their examination in this subject, it is treated in a simple straightforward manner which renders it far more interesting than many recent volumes of a similar character which we have seen. As a preliminary to the study of the actual principles of mechanism there are two chapters, one on Plane Motion and the other on Force, Work and Energy, which lay a good foundation for the subsequent chapters. A brief summary of these may be given as indicating the scope of the work. They cover in order, Mechanisms and Velocity Diagrams, Acceleration Diagrams, Slider Crank Chain, Toothed Gear Wheels and Gearing, Wheel Combinations and Epicyclic Gears, Friction, Belts and Ropes, Flywheels and Turning Moment Diagrams, Governors, Balancing, and, last, Cams. No attempt is made to apply the principles involved to the design of actual machines, nor is this required in the examinations for which the book has been specifically written, but as indicating that the author has succeeded in his task, it may be noted that a number of worked out examples taken from actual examination papers are included at their appropriate position in the text, while similar questions are given at the end of each chapter, the answers being appended at the end of the book. We need hardly add that, coming from the Oxford University Press, the production of the book leaves nothing to be desired, the diagrams especially being of ample size, with the lettering uniformly clear. We recommend this book with confidence to all those engineers, prospective and otherwise, who may be desirous of studying that Cinderella of subjects, "Theory of Machines."

A.R.

The Quantum and its Interpretation. By H. S. ALLEN, M.A., D.Sc. Pp. xiii+274; figs. 30. London: Methuen and Co., Ltd. Price 12s. 6d. net.

The state of physics is peculiar. The interplay between theory and experiment which is essential to progress is hampered by the fact that modern work lends itself so readily to abstract mathematical formulation that a theory cannot always be expressed in tangible terms, and some experimenters would go so far as to say that the theoretical aspect is merely being treated by mathematicians as a hunting ground for examples, and that they have no interest in the problem of the nature of things. "Atombau und Spektrallinien" refuted this charge in its early editions, but the subject is expanding rapidly, and the difficulty we have mentioned is not diminishing. With this in mind, it will be appreciated that it is not easy to appraise the book before us, and the view we take of its usefulness is perhaps not exactly that intended by the author, but, as we see it, it is a notable attempt to summarise recent advances in a form intelligible to the student with a reasonable mathematical equipment.

The first and last sections of "The Quantum" deal with the fundamental facts and principles and their development, and can conveniently be taken together. The nature of the book makes it impossible to give more than the barest outline of its contents here—anything more would be much the same as an attempt to review a volume of "Science Abstracts." The preliminary survey and mathematical introduction of the first two chapters call for no special comment—Dr. Jeans has spoiled us here with his classical report. Atomicity in electricity and magnetism, which follows, is specially good as a historical account of the forming of definite ideas of the atom of electricity, up to the stage of the ring electron—almost as fashionable in its time as the wave electron now is. Two chapters follow on spectra and atomic structure, into which Prof. Allen has managed to compress most of the essential facts known prior to the appearance of Hund's "Linienspektren" in 1927, and the section is completed by articles on the allied topics of quantization in space and of magnetism. Both are good, and include accounts of the experiments of Stern and Gerlach, and of gyromagnetism. We notice that Prof. Allen uses the azimuthal quantum number k in the theory of orientation, instead of the less inaccurate j, which expresses the moment of the atom as a whole. The thread is taken up again in Part III with discussions of the phenomena into which both Planck's constant and the electronic charge enter, and of the nature of radiation, including notes on the difficult conception of the angular momentum of radiation, and on the inception of the wave mechanics by L. de Broglie. The subsequent treatment of the Zeeman effect and of the spinning electron is again necessarily abbreviated. The next chapter (XVII) entitled "The New Quantum Mechanics," is one to which any one first opening the book naturally turns, and from which he is almost certain to turn away disappointed; in its present state, we doubt if Kelvin himself could give a popular lecture on what it signifies, and Prof. Allen has not tried to do the impossible. Its sub-titles are: The Work of Heisenberg, Matrix Mechanics, The Quantum Algebra of Dirac, The Undulatory Mechanics of Schrödinger, and Statistical Methods. It seems to cover what had been done up to last summer in this field. The concluding chapter is Prof. Allen's own summary of the evidence he has presented on how the quantum is to be interpreted, and, as elsewhere, he quotes at length from Larmor, Poincaré, and others.

The remaining pages can be dismissed briefly. Part II, "Special Investigations," is mainly concerned with static models of atoms and molecules, and attempts to establish relations between quanta, and tube of induction in three and four dimensions. Prof. Allen himself recognises that too great stress can be laid on magnetic phenomena. There are five appendices of mathematical and other incidental matter, an author index and a subject index. Our estimate of the book is that parts of the first and last sections are admirable reading for an honours class in physics, and that the middle part is a valuable coherent record of some unusual aspects of the quantum.

Overheard in Bath Last Week.

Two bathchair men in conversation: one had apparently asked who all the people were who were walking about in Bath. The reply overheard was:—"No, they are not gentlefolk; they are Corporation people paid to come 'ere."

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

Electrical Review Index.

The index to Vol. CII. (for the half-year ending June 30th, 1928) will be published shortly, and we shall be glad to receive the names and addresses of those who require it (free of charge) for binding purposes or wish to retain it for reference. Application should be made as early as possible to the Publisher, 4, Ludgate Hill, E.C.4.

Recent Contracts.

The BRITISH SECHERON CO., LTD., states that it has received an order for what is claimed to be the largest Diesel-electric locomotive of its class yet constructed. This locomotive, which is to be delivered to Russia, will be of the 2-10-2 type, and will be equipped with two Diesel engines made by Messrs. Sulzer, having a total output of 1,500 h.p. This is the first Diesel-electric locomotive to be fitted with individual control and totally suspended motors driving through the "Secheron" spring drive. The order was placed after a commission of Russian experts had examined many other systems; the system adopted is identical to that employed in the 4,500-h.p. locomotives supplied to the Lotschberg Railway.

Messrs. REID, FERENS & CO., Sunderland, have recently received electrical installation contracts for the following buildings:—New Collegiate Schools, Sunderland, new Durham County Council schools at Blackhall, Fishburn and West Herrington, and a new factory for Griew, Ltd., new Y.M.C.A. Buildings, the George and Dragon Hotel and the Red Lion Hotel, Sunderland.

Among the orders recently received by ECO POWER, LTD., for Foster steaming economisers are the following:—Shropshire, Worcestershire and Staffordshire Power Co., one economiser, heating surface 3,024 sq. ft.; Leeds Corporation Electricity Department, five economisers, each with a heating surface of 6,480 sq. ft.; Bedford Corporation Electricity Department, one economiser, heating surface 5,184 sq. ft.; Hull Corporation Electricity Department, five economisers, each with a heating surface of 5,620 sq. ft., and one with a heating surface of 7,200 sq. ft. for an existing boiler.

Bradford and the Sale of Fittings.

At a meeting of the Bradford City Council on June 12th a Socialist member moved a resolution providing that for the future the wiring and other work in connection with the provision of electrical installations of all kinds by the Bradford Corporation should be done by the Electricity Department instead of by registered electrical contractors. The proposition related especially to housing, and the mover claimed that the Corporation was in all branches of its enterprise doing work more cheaply and under better conditions than private contractors. He suggested that the proposal would result in a stimulus in the use of electricity for household purposes, and alleged that thousands of Bradford people were at present paying dearly for bad work accepted from private contractors. Alderman J. W. Longley (deputy chairman of the Electricity Committee) strongly opposed the proposition, and said that the highly successful Bradford Electricity Department had been built up by the help of the local electrical contractors. Private contractors were paying a penny per hour more to their electricians than the Corporation. The resolution was defeated by 39 votes to 32.

The Marking of Imported Copper.

The Standing Committee (General Merchandise) appointed by the Board of Trade under the Merchandise Marks Act, 1926, will hold its inquiry as to whether imported copper plates, sheets, strips and other rolled sections, rods and wire (other than insulated wire) and tubes should bear an indication of origin, on July 23rd and 24th. The inquiry will be held at the Board of Trade Offices, Great George Street, S.W.1. Communications should be sent to the secretary, Mr. E. W. Reardon, at that address.

Italian Lamp Manufacture.

According to *L'Energia Elettrica* the output of electric lamps in Italy amounted last year to 14,245,002, as compared with 11,941,972 in 1926, an increase of nearly 30 per cent.

Cable Manufacture in Poland.

The new electric cable works at Cracow, the first of its kind in Poland, established under the auspices of the Pressburg (Czecho-Slovakia) Cable Co., is shortly to be put in operation.

American Electrical Manufacturers' Conference.

The second annual meeting of the National Electrical Manufacturers' Association was held at Hot Springs, Virginia, from June 11th to 15th. A programme which we have received indicates that a great deal of business was done, covering a very wide field, while recreation was not overlooked.

In the Radio Division the question of price-cutting was discussed on June 7th. Mr. Clyde Kelley said that the position was very serious. Any attempt by manufacturers to impose conditions as to selling price was considered to be a violation of the Sherman Anti-Trust Law and an injury to the public. The "predatory price-cutter" was thus enabled to bring customers into his store by ruinously-cut prices on well-known merchandise and then profit by excessive prices on unknown unidentified goods. Mr. Kelley is a sponsor of a Bill "to enforce a square deal price policy so that business can build not on a basis of jungle competition, but on co-operation and confidence, both essential to the buying public."

At another meeting Mr. F. P. Vose, of the National Electrical Credit Association, gave an address on "Credit Service." He pointed out that the rapid expansion of the radio industry had attracted to it all sorts of traders—good, bad and indifferent. This fact, combined with excessive competition, price-cutting, trade abuses, &c., made the closer scrutiny of the financial status of customers essential. Mr. Vose outlined his Association's services to its members in the directions of status investigation and debt collection. He pointed out that the Association made no profits; it was run purely by the electrical industry for members of that industry.

Social Events.

The Siemens Sports Club held its sixth annual sports and gala on Saturday last at the Club's sports ground, Park Lane, Charlton. The visitors included Gen. Sir H. de la Poer Gough (vice-president of the Club) and the Mayors of Greenwich and Woolwich. The programme comprised no fewer than 57 events, but its length was compensated for by its variety. During the afternoon music was provided by Callender's Cable Works Band. The distribution of prizes was carried out by Dr. H. R. Wright, managing director, Messrs. Siemens Bros. & Co., Ltd.

The employés of the Witton Works of the General Electric Co., Ltd., held their eighth annual sports and gymkhana on June 9th at the Witton Sports Ground. The weather was fine but there was a high wind which sometimes made things difficult for competitors. The various events created great enthusiasm and many of them amusement as well. One of the humorous races was carried out with electric trucks and in this Mr. Railing, with Dr. Garrard as passenger, secured second place. There were numerous sideshows of great variety. There was strenuous competition for the challenge cups, which went to the following: The "M. J. and A. H. Railing" (tug-of-war) to the Carbon Works; the "Directors'" (best all-round department) to the Administration Department; the "Hugo Hirst" (best all-round athlete), to Mr. G. W. Clemetson; and the "H. N. Whitford" (best all-round girl), to Miss D. Percy. The cups and prizes were distributed by Mrs. Railing.

A number of inter-works cricket matches open to the London Establishments of the G.E.C., were played at Wembley on June 9th, in the "Hugo Hirst" Challenge Cup competition, when Magnet House were successful in beating the Osram Lamp Works team by six wickets. The Osram Glass Works defeated Fraser & Chalmers Engineering Works in the second round, and by so doing qualified for the final. The final round of the Tennis Challenge Cup competition resulted in the Magnet House team beating the Research Laboratories for the "Wilson" Cup, and Fraser & Chalmers' team beating Magnet House (ladies') team for the "Byng" Cup.

The newly-formed Leeds Electrical Club, on June 14th, entertained visitors from the electrical trade at Sheffield, at the Mansion House, Roundhay Park, Leeds. A cricket match had been arranged, but was abandoned owing to rain. A social meeting was held in the evening, under the presidency of Mr. W. B. Woodhouse (of the Yorkshire Electric Power Co.). Mr. C. Wood, of the Leeds club, extended a welcome to the visitors, and Mr. Sellars, president of the Sheffield Electrical Trades Cricket Club, responded, and extended an invitation to the Leeds Club to Hathersage on July 12th as the guests of the Sheffield electrical traders. Mr. Sellars expressed the hope that Sheffield would soon have an electrical club.

The annual outing of Henley's Social Club took place on June 9th, when about 130 people went to Berkhampstead.

Although at first rain clouds threatened, blue sky broke through later, and the weather was kind throughout the day. The morning was left free to tour the town and district; there was lunch at the King's Arms Hotel at 12.30 p.m.; and the afternoon was devoted to sports. The prizes were presented to the winners of the various events by Mrs. W. F. Bishop, the wife of the assistant general manager of this company. At 5 p.m. an adjournment was made to the hotel for tea, and for the rest of the evening, until 8.45 p.m., there was dancing.

Bankruptcy Proceedings.

R. J. JACOBS, 20, Portsdown Avenue, Golders Green, N.W.—The public examination of this debtor, formerly an electrical accessories factor, was held last week before Mr. Registrar Francke, at the London Bankruptcy Court. The receiving order was made in November 24th, 1926, and the public examination, fixed for March 18th, 1827, was adjourned, *sine die* in consequence of the debtor's non-attendance, but the case has now been reinstated in the list. Accounts have been lodged showing total liabilities of £9,229 (unsecured £8,336), and assets valued at £35. The debtor said that he commenced business in June, 1907, in partnership with a relative, as factors of electrical accessories at 39c, King William Street, E.C., under the style of "W. & R. Jacobs," each partner bringing in £500 as capital. In October, 1925, they sold their business to a company styled "W. A. & R. J. Jacobs, Ltd.," witness receiving as co-vendor £745 in fully-paid shares, and he acted as joint managing director until the voluntary liquidation of the company in September, 1920. He next carried on the business of a manufacturing engineer, but without success, and in August, 1922, with £200 provided by a relative, he started as a wholesale dealer in wireless accessories at Oxford Street, Manchester. That business was closed down in April, 1924. From May, 1924, until its compulsory liquidation in October, 1926, witness acted as managing director of "Brijane, Ltd.," since which time he had been without occupation. He attributed his insolvency to the failure of "W. A. & R. J. Jacobs, Ltd.," and to his liability under a guarantee for £2,000 given on its behalf. The examination was concluded.

H. JOHNSON, electrician, 25, Calder Street, Blackburn.—This debtor underwent his first public examination at Blackburn Bankruptcy Court, on June 13th. The net liabilities were stated to be £420, and the deficiency £398. Debtor attributed failure to "shortage of capital, general ill-health, the coal strike of 1926, and trade depression since then." He estimated his net loss since September 30th, 1926, to the date of the receiving order to be £130. He said that he commenced business as an electrician in February, 1923, with £20 given him by his father. He built up a connection with houses, mills and churches, and in 1925 took over premises in Whalley Range, Blackburn, which he stocked with electrical fittings, lamps, &c., for sale. He had two assistants at first and later increased his staff to four. There was a serious decline in orders in consequence of the coal stoppage of 1926, and he dispensed with the services of his assistants, gave up the shop, and recommenced working from his home. He first became aware of his insolvency in September, 1927. He was affected by severe competition and he continued trading in the hope that things would pull round. The examination was closed.

A. RAUTANEN, electrical, mechanical, and wireless engineer, 17, Princes Street, Shrewsbury.—The public examination herein was held recently at the Shire Hall, Shrewsbury. The gross liabilities were stated to be £214, of which £183 was expected to rank, with a deficiency of £175. Debtor attributed his failure to bad trade, &c. He commenced business in November, 1920, as a motor-cycle dealer at Walford Heath. He gave up that business and obtained employment until 1926, when he again commenced trading as a wireless, mechanical, and electrical engineer at his present address. He traded successfully until October, 1927. Debtor was questioned with regard to his books of account, and the hearing was adjourned for debtor to submit missing pages of his books to the Official Receiver.

A. L. ASTILL, wireless engineer, trading as the Eastern Wireless Supply Co., 362, High Street, Lincoln.—The receiving order herein was made recently on debtor's own petition. The liabilities amounted to £1,056, against assets of £136. The first meeting of the creditors was held on June 9th, at the Official Receiver's Office, Lincoln, when the case, being a summary one, was left in the hands of the Official Receiver as trustee of the estate. The following are creditors:—

	£		£
Houghton - Butcher (G.B.), Ltd.	74	Brown Bros., Ltd. ...	52
Robinson & Hands Electrical Co.	63	S.D.H. Mfg. Co., Ltd. ...	21
		Hardy, Miss L.	225
		Bankers	103

A. E. CROSS, 8, Cooksley Road, Redfield, Bristol, electrical engineer.—The first meeting of creditors was held on June 13th, at the Official Receiver's Office, Bristol, when the case, being a summary one, was left in the hands of the Official Receiver as trustee of the estate. According to debtor's statement of affairs there were ranking liabilities of £358, against assets of £1. He began business in Easton, Yorks., and was successful for about three years, but, owing to the strikes in the district, he could not recover his trade. In 1926 debtor removed to Bristol, and was fairly successful, but he was pressed by creditors in Yorkshire. He attributed his failure to loss on sale of property, bad trade, and the illness of his family.

H. H. SPEKE, 12 to 17, Bilston Street, Wolverhampton, electrician.—The public examination herein was held recently at the County Court, Wolverhampton. According to the statement of affairs there were gross liabilities of £1,510 and a deficiency of £862. Debtor stated that he commenced business in 1909 with £300 capital. He removed to his present premises in 1923, and his financial difficulties were increased by high rents, and in 1920 he was compelled to execute a deed of assignment to secure a composition of 13s. 4d. in the £ paid by instalments. He continued trading, but was always short of capital. The hearing was adjourned.

W. G. HOLMES, wireless and electrical engineer, 43, Walcot Street, Bath.—The public examination of this debtor was closed at the County Court offices, Bath, on June 11th. The liabilities amounted to £221, against assets of £90. Debtor attributed his failure to bad business and want of capital.

J. EADE (trading as James Eade & Son), 48, New Road, Skewen, Glamorgan, electrical engineer.—First and final dividend of 6½d. in the £, payable June 25th at 12, Fisher Street, Swansea.

W. J. BEATY, 79, Station Road, Ashington, Northumberland, electrical and wireless dealer.—Receiving order made on June 12th on debtor's own petition.

E. SHAW, 11, Albion Street, Huddersfield, electrician.—First and final dividend of 11½d. in the £, payable on June 20th at the Official Receiver's office, 12, Duke Street, Bradford.

O. WALKER (Albion Electric Co.), electrical contractor, 112, Albion Street, Wallasey.—Trustee, Mr. E. D. Symond, Official Receiver, 11, Dale Street, Liverpool, released June 4th.

A. F. WEBB, Ashdown, Regents Road, and 102, Duke Street, St. Helens.—Trustee, Mr. E. D. Symond, Official Receiver, 11, Dale Street, Liverpool, released June 4th.

A. J. WELLS, electrical engineer (lately in partnership with W. Bashford as Wells & Co.), 52, Princess Street, Luton.—Last day for proofs for dividend, June 26th. Trustee, Mr. A. J. Rogers, Official Receiver, The Parade, Nottingham.

P. W. WITHAM, electrical engineer, Prestea, Woodside Road, and 139, Bournemouth Road, Parkstone.—Last day for proofs for dividend, June 21st. Trustee, Mr. F. G. Wheatley, 102, High Street, Poole.

W. T. SMITH, electrical and mechanical engineer, 60, Hampden Street, Bolton.—Third and final instalment of composition of 1s. 8d. in £, payable at the Official Receiver's offices, Byrom Street, Manchester.

C. H. DAVIES, electrical engineer and contractor, 6, Stamford Arcade, Ashton-under-Lyne.—First meeting held June 21st, at the Official Receiver's offices, Byrom Street, Manchester. Public examination, June 25th, at the Town Hall, Ashton-under-Lyne.

Company Liquidations.

RADIO COMPONENTS, LTD.—A meeting of members is called for July 16th, at 17, Coleman Street, E.C., to hear an account of the winding up from the liquidator, Mr. I. T. W. Cownie.

VERA CRUZ TELEPHONE CONSTRUCTION SYNDICATE, LTD.—Winding up voluntarily. Liquidator, Mr. C. C. Baker, Finsbury Court, Finsbury Pavement, E.C.2, appointed June 8th. A meeting of creditors is called for June 29th, at the offices of Messrs. Ball, Baker, Ash & Co., of the above address. This notice is purely formal, as all creditors have been or will be paid in full.

BROMLEY (KENT) ELECTRIC LIGHT & POWER CO., LTD.—A meeting of members will be held on July 23rd, at Broad Sanctuary Chambers, Tothill Street, S.W.1, to hear an account of the winding up from the liquidators, Messrs. A. N. Rye and C. H. Jones.

ENDWELL ELECTRIC CO., LTD.—A meeting of members is called for July 17th at 4, Charterhouse Square, E.C.1, to hear an account of the winding up from the liquidators.

Private Arrangements.

H. SHINN, Seaview Road, Wallasey, electrical engineer.—The creditors interested herein were called together recently at the offices of Messrs. Louis Nicholas & Co., Liverpool, when a statement of affairs was submitted which showed liabilities of £1,473, all due to unsecured creditors, while there were fully secured creditors for £2,593, holding security valued at £3,225. There were net assets of £1,289, leaving a deficiency of £184. It was reported that the debtor had been in business since 1909, and commenced with £5 capital. In 1914 he opened a shop in Seaview Road. From 1914 to 1917 his trading was quite satisfactory. During the next three years he served in the Army, and on his demobilisation he re-opened the business, but stated that owing to the concern having been closed down for that time, he lost about £300. According to balance sheets which had been prepared, the profit in 1920 amounted to £730, in 1921 £250, in 1922 £193, in 1923, £224, 1924, £451, and 1925, £339. The drawings had been as follows: 1921 £519, 1922 £399, 1923 £413, 1924 £614, and 1925 £329. The debtor had been sued, and one creditor had obtained judgment and levied execution. He had no offer to make, and it was decided to confirm the deed of assignment which had already been executed to Mr. G. Miller (Messrs. Louis Nicholas & Co.), and a committee of inspection was also nominated, consisting of the representatives of Messrs. Baxen-

dale Bros., Ltd., Dodd & Oulton, Ltd., Stearn Electric Co., Ltd., and the Advance Lamp Co. The following are creditors:—

	£		£
Baxendale Bros., Ltd. ...	603	Falk, Stadelmann & Co.	49
Dodd & Oulton, Ltd. ...	244	Phillips Lamps, Ltd. ...	48
Advance Lamp Co. ...	94	Stearn Electric Co., Ltd.	59
Electrolux	50	General Electric Co., Ltd.	25

Dissolution of Partnership.

BURGESS & GARFIELD, electrical engineers, &c., 1270 and 552B, Coventry Road, Birmingham.—Mr. F. Burgess and Mr. A. G. Garfield have dissolved partnership.

For Sale.

By order of the Receiver, Messrs. Leopold Farmer & Sons, in conjunction with Messrs. Tyler & Co., will sell by auction on July 3rd, at Dunbar's Cooperage, Ltd., Glengall Road, S.E., 23 electric motors. The Trustees under the deed of assignment of J. H. Holmes & Co. invite offers for the old-established electrical manufacturing business at Portland Road, Newcastle-on-Tyne, including freehold premises, plant, machinery, stock-in-trade, &c. (See our advertisement pages to-day.)

Manufacturers and "Safeguarding."

Last week the Prime Minister received a deputation from the National Union of Manufacturers upon the subject of the procedure followed in connection with the safeguarding of industries. Mr. George Terrell (president of the N.U.M.) maintained that very meagre results had been attained so far. Only nine small industries, representing from 50,000 to 60,000 employés, had succeeded in obtaining duties, whereas there were 16½ million people engaged in industry. A number of other speakers voiced the views of their particular industries, and in reply Mr. Baldwin said that the deputation had presented a case which called for careful examination by the Government in connection with the administration of any policy which it might adopt and recommend to the country at the proper time.

"Exide" Service Agents' Conference.

The eighth annual convention of the "Exide" service agents took place at the Grand Hotel, Scarborough, on June 12th and 13th. Over half of the 600 agents in this country were present, representing a big increase on previous attendances, and during two full days of strenuous business sessions, they discussed questions of design, of manufacture, of re-charging and delivery services, which cannot fail to be of permanent advantage to the user of storage batteries.

Unemployment.

There was an increase of 58,970 in the number of registered unemployed during the week ended June 4th. The total at that date was 1,160,000 against 1,101,030 on May 21st and 1,089,640 on June 6th, 1927.

Trade Announcements.

Messrs. PHILIPS LAMPS, LTD., have opened larger premises at Leeds, which will enable them to hold larger stocks of their products thereby facilitating deliveries. The address is Philips House, Park Lane, Park Square, Leeds. Telephone: Leeds 29001-2-3.

Mr. A. E. LOE, formerly with B.E.N. Patents, Ltd., has been appointed general sales manager of the garage equipment, tool and motor accessory section of the ROTHERMEL CORPORATION, LTD.

Mr. R. J. PETTITT has been appointed general sales manager to B.E.N. PATENTS, LTD.

The Birmingham address of the WANDSWORTH ELECTRICAL MFG. CO., LTD., is now Imperial Works, Kenyon Street. Telephone: Central 5211; telegrams: "Current, Birmingham."

The new general offices of the FOSTER ENGINEERING CO., LTD., at Morden Works, Wimbledon, S.W.19, were opened this week. The telephone number is now Wimbledon 5466 (five lines).

Messrs. WARD & GOLDSTONE, LTD., state that at present they are not represented in London, but arrangements are being made for representation.

The telephone numbers of BRITISH ELECTRIC LAMPS, LTD., Spencer Hill Road, Wimbledon, S.W.19, are now Wimbledon 5441, 5442, and 5443.

THE LONDON ELECTRIC FIRM, Brighton Road, South Croydon, states that its telephone numbers are now: Purley 1222 and 1223.

Local Exhibition.

ISLINGTON, N.—Last week was Civic Week in Islington and in connection with it there was an exhibition of local industries in the Agricultural Hall. The Borough Electricity Department had a large and varied collection of electrical apparatus provided by a number of manufacturers. The cookers shown included the following makes: "Tricity," "Magnet," "Jackson," and "Metro-Vick," while "Jackson" and "Bastian" water heaters were on view. A refrigerator was shown by Electrolux, Ltd., tools by B.E.N. Patents, Ltd., furnaces by Automatic and Electric Furnaces, Ltd., domestic appliances by the General Electric Co., Ltd.; fires, kettles, &c., by Metro-Vick Supplies, Ltd.; small appliances by the Dowsing Radiant Heat Co., Ltd.; and radiators, &c., by the British Electric Transformer Co., Ltd. There were also on view "Belling" and "Magicoal" fires, while the lighting of the stand was by the General Electric Co., Ltd. The Islington Borough Council has convenient hire-purchase arrangements and an attractive domestic tariff.

Argentine Electrical Imports.

The Argentine Government has recently issued statistics of the country's foreign trade during the past twelve months. The following table shows the values of the various descriptions of electrical materials imported in that year, and the figures are compared with those for 1926. The values are those of the Argentine Customs Department. The gold peso equals about 4s. Particulars of the countries of origin of the imports are not yet available:—

	Gold Pesos. 1926.	Gold Pesos. 1927.	Gold Pesos. Inc. or dec.
Accessories for underground cables	143,100	91,600	− 51,500
Unspecified accessories ...	1,165,000	800,000	−365,000
Accumulators	77,000	263,000	+186,000
Insulators of earthenware or porcelain	244,000	158,000	− 86,000
Glass insulators	600	2,600	+ 2,000
Electric wire and cable ...	7,272,000	7,404,000	+132,000
Ammeters and voltmeters ...	139,500	70,500	− 69,000
Telephone apparatus	274,000	152,000	−122,000
Telegraph apparatus	15,600	6,300	− 9,500
Clamps and porcelain tubes	17,300	24,000	+ 6,700
Pushes for electric bells ...	14,500	15,000	+ 500
Electric bells	57,000	50,000	− 7,000
Electric light carbons ...	10,000	8,000	− 2,000
Insulating tape	109,000	158,000	+ 49,000
Switches entered by weight (kg.)	180,000	72,000	−108,000
Switches entered by number	14,000	16,000	+ 2,000
Cut-outs and fuses	36,800	29,400	− 7,400
Switchboards for bells and telephones	9,600	10,700	+ 1,100
Dynamos and motors ...	1,917,000	2,024,000	+107,000
Vulcanised fibre	37,600	42,000	+ 4,400
Circuit breakers	19,000	32,000	+ 13,000
Quick-break switches ...	186,000	162,000	− 24,000
Incandescent lamps	740,000	783,000	+ 43,000
Unspecified apparatus ...	1,164,000	1,377,000	+213,000
Wireless telephone material	661,000	1,566,000	+905,000
Wireless telegraph material	1,000	64,000	+ 63,000
Telegraph material	78,000	73,000	− 5,000
Telephone material	52,000	17,000	− 35,000
Electric meters	916,000	414,000	−502,000
Parts for batteries and accumulators	544,000	467,000	− 77,000
Small electric motors ...	235,000	269,000	+ 34,000
Batteries	672,000	977,000	+305,000
Porous jars for batteries ...	8,000	16,000	+ 8,000
Lampholders	188,000	172,000	− 16,000
Distribution boards	96,000	26,000	− 70,000
Plugs	3,000	11,000	− 8,000
Wall sockets	10,000	8,000	− 2,000
Insulating tubes	613,000	780,000	+167,000
Glass jars for batteries and accumulators	17,500	27,000	+ 9,500
Electric fans	94,000	164,000	+ 70,000
Total of all electrical material	18,049,000	18,803,000	+754,000

Charitable Works Visits.

A series of visits to industrial works has been arranged by the King Edward's Hospital Fund for London. One of the factories included is the Osram-G.E.C. Lamp Works, Brook Green, Hammersmith, on June 27th. Tickets (price 7s. 6d.) can be obtained from the Secretary of the Fund, 7, Walbrook, E.C.4

New Catalogues and Lists.

THE AUTOMATIC TELEPHONE MFG. CO., LTD., Milton Road, Edge Lane, Liverpool.—An illustrated catalogue (with separate price list) of the company's mine telephones and signalling apparatus. Some of the pictures illustrate the equipment in use. Relevant passages of the regulations are quoted, and wiring diagrams are given.

FURSE WHOLESALE, LTD., Traffic Street, Nottingham.—A price list of electrical materials, appliances and accessories. (No. 21/28.)

THE DUBILIER CONDENSER CO. (1925), LTD., Victoria Road, North Acton, W.3.—An illustrated folder advertising the company's condensers for power-factor improvement. Examples of savings to be effected by their use are worked out.

MESSRS. JOHNSON & PHILLIPS, LTD., Charlton, S.E.7.—A folder containing a series of curves illustrating the results of tests on the company's "H." and "H.S.L." 33,000-V cables.

MESSRS. CREWE & CO., 342, Gray's Inn Road, W.C.1.—Illustrated price lists of trucks, trolleys and ladders.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD., Hamilton House, Victoria Embankment, E.C.4.—A price list of various types of flexibles for automobile lighting, starting and ignition.

MESSRS. GREENWOOD & BATLEY, LTD., Albion Works, Leeds.—A well-illustrated catalogue of "Greenbat" electric industrial trucks, tractors, trailers, cranes, &c.

THE MARCONIPHONE CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication No. 504, containing fully-illustrated details of the company's radio components and accessories. Diagrams and instructions for installation are given in many instances.

MESSRS. ALFRED WISEMAN, LTD., Glover Street, Birmingham. —Illustrated Catalogue No. 10, containing particulars and prices of a wide variety of tramway material, &c.

MESSRS. HERBERT MORRIS, LTD., Loughborough. — A humorous illustrated folder advertising the company's goods-handling equipment.

THE SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, W.C.2.—A folder containing a fully-explained illustration of the "A.B.C. Spinner" washing machine.

GUEST'S BRASS STAMPING CO., Cardigan Works, Belmont Row, Birmingham.—List G.B.S.3, a pamphlet illustrating examples of hot die pressings in brass, copper and yellow metal.

BROOKHIRST SWITCHGEAR, LTD., Northgate Works, Chester. —A pamphlet containing a list of the equipment which is on view at the company's showroom at Australia House, Strand, W.C.2.

MR. J. L. LAKE, 5, South Street, South Place, E.C.2.—A price list of rubber-insulated wires and cables for various applications made by the Société Industrielle des Téléphones.

THE FOSTER ENGINEERING CO., LTD., Morden Works, Wimbledon, S.W.19.—A booklet and a series of leaflets containing illustrations, particulars and prices of "Apex" ironclad switch- and fuse-gear of a number of patterns.

THE JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, S.W.1.—A priced and illustrated leaflet advertising the "No. 720" multi-purpose electric fire.

THE MULLARD WIRELESS SERVICE CO., LTD., Nightingale Lane, Balham, S.W.12.—Illustrated leaflets describing the company's screened grid receiving valves and low-frequency transformer.

MESSRS. C. A. VANDERVELL & Co., LTD., Acton, W.3.—Particulars of a window display for the company's battery service agents and details of a competition in connection with it.

THE BENJAMIN ELECTRIC, LTD., Brantwood Works, Tariff Road, Tottenham, N.17.—The May-June "Benjamin Reflector," containing illustrated notes on the company's lighting equipment and illumination generally.

THE BERGMANN ELECTRIC CO., LTD., 82, Victoria Street, S.W.1.—Price lists of electric fans, and a.c. and d.c. motors.

Industry in Sweden.

A volume bearing this title has been published by the Federation of Swedish Industries, reviewing in an interesting manner the history and achievements of many branches of Swedish industrial activity. It is commenced with a chapter on Sweden's natural resources in relation to industry, in which special attention is given to the production of electricity by water power. The capital in hydro-electric plant and distribution systems is estimated at 1,000 million kronor (about £55,000,000). The growth of the electrical industry is dealt with, the principal manufacturing concerns being mentioned. The total annual value of electrical manufactures is given as about 75 million kr. (approximately £4,000,000). The work is well illustrated, and gives a very complete picture of the scope and nature of the products of industrial Sweden.

Electricity Meter Approved.

The Electricity Commissioners have approved the construction and pattern of the "Siemens-Schuckert" Type W.8, single-phase watt-hour meter rated at 15 A, 225 V, 50 cycles.

Book Notices.

"Kelly's Directory of the Merchants, Manufacturers and Shippers of the World." Two vols. (Pp. 4,585.) London: Kelly's Directories, Ltd. Price 64s., post free.—This is the 42nd edition of this useful directory, which has been revised and brought up to date. In addition to the inclusion of more than a million and a half names covering over 20,000 places, a large amount of commercial information is given, and reference is simplified by a clear explanation of the arrangement of the various sections.

"Illuminating Engineering," by F. E. Cady and H. B. Dates. Pp. xv+515; figs. 186. Price 25s. net. "Alternating Current Machinery," by R. E. Brown. Pp. xi+274; figs. 166. Price 15s. net. London: Chapman & Hall, Ltd.

"Abderhalden: Hdb. d. biolog. Arbeitsmethoden; Elektronenund Ionenröhren," by F. Scheminzky. Pp. 440. Berlin: Urban & Schwarzenberg. Price Mk. 25.

"Elektrizitätszahler-technik," by Dr. Ing. F. Bergtold. Pp. viii+250; illustrated. Stuttgart: F. Enke. Price Mk. 16.

"Foundations," by W. Simpson. Pp. xviii+256; figs. 231. London: Constable & Co., Ltd. Price 18s. net.

"Standards Year Book," 1928, compiled by the U.S. National Bureau of Standards. Pp. 399. United States Government Printing Office. Price $1

The McGraw-Hill Publishing Co., Ltd., has issued a list (No. 13) of books on mathematics and physics, containing particulars and prices of about 50 works by American authors.

"Excavating Machinery," by W. Barnes. Pp. xvi+247; figs. 160. Price 42s. net. "Docks, Wharves and Piers," by F. M. Du-Plat Taylor. Pp. xxvii+495; figs. 454. Price 70s. net. London: Ernest Benn, Ltd.

"*Journal* of the Institution of Electrical Engineers." Vol. LXVI. June, 1928. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

"Measurement and Calculation," by N. R. Campbell. Pp. x+293. London: Longmans, Green & Co., Ltd. Price 15s. net.

G.E.C. Lampholder Patent Application.

Application has been made to the High Court on behalf of Messrs. M. J. Railing and J. H. Collings and the General Electric Co., Ltd., for an extension of letters patent No. 27,503 of 1912, for "Improvements in and relating to electric lampholders." The originating summons will be heard at the Law Courts on July 17th.

New Belgian Company.

A new company has lately been formed in Brussels (11, Rue de la Pepinière) with a capital of 4½ million francs and the title La Société Belge des Lampes à Incandescence Luxor, to manufacture electric lamps.

Reduction of Capital.

MAJOR & Co., LTD., AND REDUCED.—A petition for the confirmation of the reduction of the capital of this company from £450,000 to £326,000 has been presented to the High Court and will be heard on June 25th.

The German Cable Industry.

A denial has been issued of a report that negotiations are proceeding between the leading German cable manufacturing works with the object of preventing underselling and over-production. Before the war this branch had a large export trade, but exports are now much smaller, despite the growing use of cables abroad. As is known, the cable and wire industry is combined in syndicates, and in syndicate circles there now appear to be discussions proceeding concerning the situation of the industry, particularly regarding the prolongation of the syndicates. It is also stated that the industry is endeavouring to get into touch with makers in other countries so as to reach an agreement, but this involves difficult and complicated negotiations which are in an initial stage, so that nothing can be said about the probable result.

Prices of Raw Materials.

Messrs. James Forster & Co., in their letter dated June 16th, stated: "An easier tendency has been in evidence this week, lead prices declining daily and closing at the lowest. At the same time declarations of Mexican lead, due in a few days, widened the contango to 7s. 6d. per ton. The market had a steadier appearance yesterday, but unless present conditions alter there does not seem to be much justification for a higher level of values. The Board of Trade returns for May show imports of 21,069 tons and exports of 4,689 tons, leaving 16,380 tons for home absorption. The large exports are due to shipments of lead to Russia."

Messrs. F. Smith & Co. report, June 19th:—Copper electrolytic) bars, £69 5s., 25s. inc.; do., do. sheets, no change; do., do. wire rods, £79 5s., 25s. inc.; do., do. h.c. wire, 9 15/16d., ¼d. inc.

Messrs. James & Shakespeare report, June 19th:—Copper bars (best selected) sheet and rod, no change; English pig lead, £22, 15s. dec.

Messrs. Edward Till & Co. report, June 19th:—No change in the price of india-rubber, Para fine.

Lighting and Power Notes.

Barnsley.—MAINS EXTENSIONS.—The Corporation Electricity Committee has recommended that the a.c. mains be extended in Church Street, Eastgate, Park Road and Sheffield Road, including the reconstruction of the public lighting control, at an estimated cost of £4,881.

Belgian Congo. — HYDRO-ELECTRIC DEVELOPMENT. — Good progress is being made with the construction of the hydro-electric power station in the Belgian Congo by the Societé des Forces Hydro-Electriques du Katanga. The temporary hydro-electric plant to supply the power necessary in connection with the constructional work has been completed. The plant for the main station has been ordered, and is expected to be ready for operation by the middle of 1929.

Birkenhead.—STREET LIGHTING.—The Town Council has approved the appointment of Mr. P. J. Robinson, electrical engineer and city lighting engineer to the Liverpool Corporation, to report on the street lighting in Birkenhead. It was explained by the Watch Committee that it was not satisfied with the present arrangements, and considered it advisable to have expert information.

Birmingham.—LOAN SANCTIONED.—The Corporation Electricity Committee has received sanction to the borrowing of £700,000 for mains.

Blackburn.—YEAR'S WORKING.—We have received from Mr. P. P. Wheelwright, borough electrical engineer, a copy of his report, together with the statement of accounts, on the working of the electricity undertaking for the year ended March 31st. The total revenue amounted to £203,362, and working expenses were £80,279, leaving a gross profit of £123,083. The figures for the preceding year were: Income, £189,120; working ex-

penses, £121,369; gross profit, £67,751. To the gross profit was added an unemployment grant of £3,551, and the proceeds from the sale of old machinery amounting to £338, making a total of £126,975. After payment of capital and other charges there was a net deficit of £3,262, as compared with a deficit of £58,660 in 1926-27. The capital expenditure during the year amounted to £44,232, the major portion of which was spent on mains and distributing plant. The sales of electrical energy increased from 21,890,549 to 24,471,514 kWh, and the maximum supply demanded from 11,461 to 14,725 kW. The average price obtained per kWh fell from 2.02d. to 1.98d. The total connections increased to 43,349 kW.

Bradford.—NEW PLANT.—The Corporation Electricity Committee has approved a recommendation by a special advisory sub-committee to the effect that, for the Valley Road power station extension, the new No. 9 turbo-generator be of 20,000-kW capacity, instead of 25,000 kW as originally proposed.

NEW TRANSFORMER CHAMBER.—The Committee has approved a scheme for the provision and equipment of a transformer chamber at Hall Lane, at an estimated cost (including mains) of £2,533, and authority has been given to seek borrowing powers.

Burnley.—NEW ELECTRICITY CHARGE.—With a view to cultivating a day-time load, the Corporation has introduced the following alternative rate: A fixed charge of 20 per cent. of the ratable value of dwellings up to £60, and 10 per cent. on amounts above that value, plus ½d. per kWh for electricity consumed.

Church Stretton.—STREET LIGHTING.—The Urban District Council has accepted the tender of the Shropshire, Worcestershire and Staffordshire Electric Power Co. for public lighting for the season by 79 lamps at £265.

Colchester.—LOAN SANCTIONED.—The City Council has received sanction to a loan of £20,000 for mains and services.

Continental.—GERMANY.—A power station operated by high-pressure steam has recently been completed in connection with the collieries of the Lothringen Bergbau Gesellschaft at Gerthe, near Bochum. The installation comprises six Hanomag tubular boilers with a heating surface of 6,458 sq. ft. and a superheating surface of 4,950 sq. ft. They are designed to generate steam at a pressure of 28 atmospheres and a temperature of 470 deg. C.; four of the boilers are fired by pulverised coal and two by pulverised fuel and gas. In order to provide a reserve supply of steam for emergencies a Ruths steam container with a capacity of 4,230 cu. ft. has also been installed. The plant supplies steam to two 10,000-kW turbo-generators and one set of 1,250 kW.

ITALY.—A new transformer station has recently been completed and put into operation in Turin. The plant comprises one 36,000-kVA transformer which steps down the power received from the Maen, Covalou and Isollaz power stations from 120,000 to 22,000 V. A second 45,000-kVA, 120/65/8-kV transformer is shortly to be installed, while later another 45,000-kVA transformer is to be added.

Conway.—STREET LIGHTING.—The Corporation has had under consideration the question of the relative cost of electricity and gas for street lighting, and has voted in favour of electricity. The matter has now been referred to the Electricity Committee, which is expected to prepare schemes for the consideration of the Council with a view to the substitution of electricity for gas during the coming winter.

Dartford.—SUPPLY FOR HOUSING ESTATE.—The Urban District Council has decided to install 1s. slot prepayment meters in the houses on the Lowfield Street housing estate, and to supply electricity at 8d. per kWh.

Hastings.—LOANS.—The Corporation Electricity Committee has obtained sanction to borrow £5,000 for meters, £10,000 for mains, and £1,000 for transformer and sub-station equipment.

Application is to be made for sanction to a loan of £10,600 for house services.

Hetton (Co. Durham).—INQUIRY.—Mr. F. G. Williams, Inspector of the Ministry of Health, held an inquiry on June 12th in connection with the Urban District Council's application for sanction to borrow £5,376 for converting the street lighting in the district from gas to electricity. On behalf of the Council it was stated that the average annual cost of gas lighting for the past three years for 225 lamps was £1,217, while the estimated annual cost of electric lighting with 305 lamps was £1,285. After the Inspector had expressed the opinion that the scheme would not prove a burden on the rates, the local Ratepayers' Association withdrew its opposition, and consented to the scheme as outlined.

Irish Free State.—SHANNON SCHEME PROGRESS.—The Shannon Scheme Electricity Supply Board set up by the Free State Government is now actively engaged in arranging for the construction of distribution networks throughout the State. The Board proposes to have the first supplies to towns and villages in operation by October, and by November it is hoped that Kilkenny and Wexford, and probably one or two other important centres, will have a full service. Work in the Leinster towns is given precedence because it will be possible to supply these towns from Dublin pending the supply from the Shannon.

London.—ISLINGTON.—The Borough Council Electricity Committee has considered a report from the electrical engineer as to the necessity of making provision for the future development of the distribution system of the electricity undertaking. The electrical engineer suggests that the interests of the undertaking can best be served by dividing the area of supply into sections. In each section there would be a sub-station which would receive energy from the power station through one of the three-phase e.h.p. 6,600-V transmission mains, and convert this energy to single-phase at 2,000 V, thereby increasing the capacity of the existing transmission mains. As further demand arises, these sections would be increased, and at a future date each sub-station would be interconnected by means of an e.h.p. link, thus ensuring an alternative supply in the event of the e.h.p. feeder breaking down. The proposals will, so far as the transmission system is concerned, be in accordance with present-day practice, and enable the undertaking to co-operate more effectually with the South-East England Electricity Scheme. The estimated cost of the scheme is as follows: Scott transformers, cables, and accessories, £7,000; switchgear for feeders, £8,910; e.h.p. feeders, £53,775; buildings, land, &c., £12,000.

ST. MARYLEBONE.—The supply of electricity over a considerable area of Central London was cut off for about 45 minutes on June 14th, owing to a breakdown at the Marylebone power station.

Luton.—INQUIRY.—A Ministry of Transport inquiry was held on June 5th respecting objections to the proposal of the Corporation to carry an overhead transmission line from Linslade to Liscombe House, Soulbury. It was stated that the extension had been delayed by failure to get consent to carry the line over land owned by Merry's Trustees. The Town Clerk said that the overhead cables would not interfere with agricultural operations. There was no other way of avoiding Mr. Merry's land without making the cost prohibitive, the alternative being an underground cable, which would increase the cost by over £700. The cable would supply electricity to the villages of Soulbury and Stoke Hammond. It was intimated that there was no objection to the proposal from the Bucks County Council and the Linslade Council.

Manchester.—YEAR'S WORKING.—We have received from Mr. H. C. Lamb, chief electrical engineer and manager of the Corporation electricity undertaking, a copy of the abstract of accounts and report on the working of the undertaking for the year ended March 31st last. The total income amounted to £1,604,167, as compared with £1,643,137 in the preceding year. Working expenses were lower at £739,750, as against £984,106, leaving a gross profit of £739,750 (£659,031). From this surplus the following charges had to be met: Interest, £257,968; sinking fund, £299,531; income tax, £71 309. There was therefore a net profit of £110.942, as compared with £40,659 in the previous year. Expenditure on capital account during the year totalled £803,199, the chief items being £292,669 for buildings, machinery and switchboards at Barton power station, £66 255 for transformer and distributing stations, and £404,965 for mains, services and meters. The total now expended on the undertaking stands at £9.944.355. The sales of electrical energy increased from 323,547,741 to 353,492,142 kWh, and the electricity not accounted for amounted to 67 464,718 kWh, or 15.01 per cent. of the total generated (449,511,830 kWh). The maximum supply demanded rose from 140,860 to 154,110 kW, and the average price obtained per kWh fell from 1.20d. to 1.07d. Good progress was made during the year with the extensions to Barton power station. The buildings and structural work were practically completed, and the erection of the 40,000-kW turbo-alternator was in progress. Of the three new boilers which are being installed, the first, which is equipped for burning pulverised fuel, was almost completed, and the erection of the two stoker-fired units was well advanced. It is expected that the new section of the plant will be ready to go into commission in August next. Plans for the further extension and completion of the station are under consideration. In the Electricity Commissioners' returns for the year 1926-27 of the principal operating statistics for Great Britain, Barton station is again placed first for thermal efficiency. Six new public supply sub-stations were put into commission during the year, and extensions or replacements were carried out at 18 existing stations. The mains laid amounted to 90 miles, bringing the total to 909. Considerable development of the cooker-hiring scheme was made, and the number of cookers installed during the year was 1,285, bringing the total up to 4,314.

PROGRESS DURING APRIL.—During the month of April the Corporation electricity undertaking showed an increase in connections of 1,727 kW, bringing the total up to 353,003 kW; and the number of applications received for supply, including consumers for additional supplies, was 969, representing a total of 2 486 kW. The number of hired cookers connected increased by 75, bringing the total actually on circuit to 4,391. Applications for the hire of cookers totalled 95. A new 125-kVA transformer sub-station was put into commission at Messrs. Hollands, Ltd. (Albert Mill).

PRICE REDUCTIONS.—The following reductions have been approved by the Corporation:—Street lighting within the city: Running charge reduced by ½d. per kWh; fixed charges in respect of costs for interest and debt redemption to be reduced by 10 per cent. Lighting: Flat rate from 5d. to 4½d. per kWh. Cooking and heating under the domestic power flat

rate and business premises flat rate: From 1½d. to 1d. per kWh. H.p. power: Varying from £4 7s. 6d. for the first 50 kW of demand to £3 2s. 6d. for all over 500 kW, the running charge and supplementary coal charge to remain unaltered.

Oldham.—LOANS.—The Corporation Electricity Committee is applying for sanction to borrow £24,650 for steam piping and £1,074 for works transformers.

Paisley.—LOANS SANCTIONED.—The Corporation Electricity Committee has received sanction to a loan of £23,300 for the purposes of the electricity undertaking.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

EXMOUTH.—*The Electric Supply Corporation, Ltd.*—Lighting: From 10d. to 8d. per kWh.

EXETER.—Within the borough—Lighting: From 5½d. to 5d. per kWh, with a discount of 5 per cent. Outside the borough—Lighting: From 8d. to 7½d. per kWh. Power and heating: From 3d. to 2½d. per kWh. Cooking: From 2d. to 1½d. per kWh.

BROMLEY (KENT).—Lighting: From 7d. to 5d. per kWh. Heating and cooking: From 3d. to 2d. per kWh and to 1½d. per kWh if a cooker of at least 2 kW is installed. Power: Varying from 2½d. per kWh for the first 3,000 kWh per quarter to 1½d. per kWh for over 6,000 kWh. Consumers of over 30,000 kWh per annum: A quarterly charge of 30s. per kW, plus ½d. per kWh, with coal clause. Kinemas, &c.: Flat rate of 5½d. per kWh.

STRATFORD-ON-AVON.—*The Stratford-on-Avon Electricity Co., Ltd.*—Lighting: A reduction of 1d. per kWh.

GRANTHAM.—*Urban Electric Supply Co., Ltd.*—Lighting: From 9d. to 8½d. per kWh; the contract rate to 3d. per kWh. Power: First 3,000 kWh, 4d. per kWh; beyond, 2d. per kWh. Heating: 3d. per kWh.

MARLBOROUGH.—Lighting: From 9d. to 8½d. per kWh.

SHREWSBURY.—Lighting: Flat rate from 4d. to 3d. per kWh. Power, cooking and heating: From 2d. to 1d. per kWh, with a discount of 10 per cent. to consumers of over 1,000 kWh per quarter.

DUNDEE.—Lighting: From 4½d. to 4½d. per kWh. Power, heating, &c.: From 2½d. to 2½d. per kWh.

HOVE.—Lighting: Varying from 5d. per kWh for the first 10,000 kWh per annum to 3d. per kWh for over 20,000 kWh. Power, heating and cooking: From 1½d. to 1½d. per kWh. Street lighting: From 3½d. to 2½d. per kWh.

DORCHESTER.—Lighting: From 9½d. to 9d. per kWh. Power: From 2½d. to 2d. per kWh.

PENMAENMAWR.—Heating and cooking: To users of slot meters, from 2½d. to 2d. per kWh.

Sandwich.—LINE ACROSS THE STOUR.—The Town Council has consented to the South-East Kent Electric Power Co. carrying a 33,000-V 3-phase duplicate circuit overhead transmission line across the river Stour at a height of 28 ft. from the surface of the river at high water, provided the cable will not interfere with navigation.

Southend-on-Sea.—INQUIRY RESULT.—As the outcome of an inquiry held last February, the Electricity Commissioners have refused the application of the Town Council for a Special Order to extend its area of electricity supply so as to include the Rochford rural district and the urban district of Canvey.

South Shields.—BULK SUPPLY CHARGES.—The Corporation Electricity Committee has adopted a recommendation of the electrical engineer that the following amended offer from the County of Durham Electric Power Co., Ltd., be accepted for a bulk supply of electricity in the added area: The "unit" charge to be 0.7d., with discounts of 10 per cent. for energy consumed in excess of 50,000 kWh, and up to 100,000 kWh per quarter, 20 per cent. from 100,000 to 200,000 kWh, 25 per cent. from 200,000 to 400,000 kWh. and 30 per cent. for all electricity consumed in excess of 400,000 kWh. The kW demand charge to remain at £4 10s. per kW of demand per annum, and the coal clause basis to be reduced from 30s. to 15s. per ton.

Spalding.—SUPPLY TO CROWLAND.—The Urban District Council has applied for sanction to a loan of £2,000 to meet the cost of supplying electricity to the parish of Crowland. The Council has adopted the following scale of charges in the parish: Lighting, 9d. per kWh, reducible to 8d. when 50 consumers are connected up. Power, 3½d. per kWh, subject to the usual scale of discounts.

Special Orders.—Application has been made to the Electricity Commissioners for a Special Order by the Power Development Co., Ltd., authorising it to supply electricity in the rural districts of Petworth and Thakeham, and parts of the rural districts of Steyning West and Horsham.

The Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them authorising Burnley Corporation to supply electricity within the township of Briercliffe.

Referring to the Special Orders mentioned in our last issue as made for the Northampton Electric Light & Power Co., Ltd., the company points out that the Commissioners have made two Orders and submitted them to the Minister for confirmation. One Order is in respect of the rural district of Crick and parts of the rural districts of Brixworth and Oxendon in the county of Northampton. The other Order is in respect of the Borough of Brackley, the rural districts of Middleton Cheney and Brackley, and parts of the rural districts of Daventry and Towcester in the County of Northampton, and the Borough of Buckingham and the rural districts of Buckingham and Winslow in the County of Buckingham.

St. Helens.—LOANS.—The Corporation is to apply for sanction to the following loans: £2,935 for a supply of electricity to the Nuera Art Silk Co.; £1,740 for a supply to Sutton; £735 for a supply to Bold; £1,200 for overhead cable to Cannington Shaw's works; and £28,000 for extensions to the electricity works, including £4,405 for a battery.

CHANGE-OVER.—Application is to be made for consent to change over the system of supply from d.c. to a.c., and, to meet the cost of the change, £2,000 per annum is to be allocated from the reserve fund for a period of five years.

Walton-on-Thames.—ELECTRICITY SUPPLY.—The Urban District Council, on June 12th, decided to expend £20,000 in order to place the electricity undertaking on a thoroughly efficient and up-to-date basis. This decision is the outcome of a report by the manager and engineer and the advice of Messrs. Handcock & Dykes, who were consulted in the matter. Sanction to a loan for the necessary work is to be applied for. The Electricity Committee states that with the new bulk supply, coupled with more efficient and up-to-date methods of distribution, a reduction in the prices will be made, and this, with an all-in tariff, will increase the demand for electricity for domestic purposes.

Winchester.—LOANS SANCTIONED.—The City Council has received sanction to the following loans:—Mains and services, £5,000; feeder cable, £3,260; meters, £2,500. A further sum of £250 is to be expended on the purchase of electric cookers to be let out on hire.

Worcester.—NEW SUB-STATION.—The Town Council has approved a scheme for the erection of a sub-station in the Porcelain Works Yard for the purpose of giving a reliable supply for heating electric kilns. The cost of the scheme is estimated at £2,500.

Tramway and Railway Notes.

Bradford.—RAILLESS CARS.—At the Corporation Tramways Committee the manager reported on the condition of the permanent way on the Thackley and Allerton tramway routes, and the Committee decided that, in view of the powers contained in the Corporation's Provisional Order now before Parliament, no further expenditure be incurred on the permanent way on those sections, and that the manager be instructed to take the necessary steps for the conversion of the routes in order that railless cars may be put into operation as soon as the requisite powers have been obtained.

Continental.—GERMANY.—The first service of electric trains on the Berlin District Railway was commenced on June 11th. When the electrification work is completed the speed of the trains will be 25 per cent. higher than at present. It is possible to travel round Berlin for less than twopence.

Great Yarmouth.—YEAR'S WORKING.—The accounts of the Corporation tramway undertaking (general manager: Mr. P. G. Campling) for the year ended March 31st last record a total revenue of £37,455, as compared with £37,049 in the preceding year. Working expenses amounted to £22,099, as against £21,706, leaving a gross profit of £15,355 (£15,343), to which was added bank interest of £715, and an unemployment grant of £1,331, making a total of £17,402 available. After payment of capital charges there was a net surplus of £5,221, as compared with £4,784 in 1926-27. The number of passengers carried increased from 4,104,323 to 4,163,784, and the car miles run from 526,708 to 546,775.

Portsmouth.—TRACK RENEWAL.—The Corporation Tramways Committee has decided to reconstruct the track from Portsbridge to Cosham at a cost of £6,400.

Rotherham.—RAILLESS CARS.—The Corporation Tramways Committee has under consideration a suggestion by the tramways manager to substitute railless cars for tramcars on the Broom Section as far as possible, using the tramcars for peak load periods.

Sao Paulo.—RAILWAY IMPROVEMENTS.—The Government Commission appointed to inquire into traffic conditions on the Sao Paulo Railway has recommended the replacement of the present steam steel-cable traction by a double-track rail-

way of the ordinary or gravity type, electrically operated. Electrical power can be obtained locally on advantageous terms, and new services could therefore be operated with greater economy and efficiency. The line will start from near the present Sao Paulo Railway, at the spot on the mainland nearest to the port of Santos. After traversing 16 km., it will reach a point 1,591 ft. above sea level, and, still with the same gradient, will continue 9 km. through a series of tunnels in the direction of Ribeirao Preto, on the Mogyana Railway.—*Reuter's Trade Service* (Sao Paulo).

Southern Railway.—NEW ELECTRIC SERVICES.—The extension of the Southern Railway's scheme of electrification to the central and eastern suburban sections of the system had its first serious test on June 18th. The new system involves 79 miles of track. *The Times* reports that an official statement issued by the railway during the morning said that up to 10 o'clock 548 trains had been dealt with for London Bridge, Cannon Street, and Charing Cross. The average arrival of all trains was ten minutes late, and many trains were on time. An electric signal failure at Borough Market Junction caused the only serious delay. A statement issued at night said that the evening services were interfered with owing to a point failure at an important junction of lines immediately outside London Bridge on the central side. The failure lasted for 23 minutes, during which time considerable delay was inevitably caused to outgoing and incoming trains, resulting in late departures from the central side of London Bridge during the rush-hour period. Before the failure the evening working was good, and throughout the rush-hour the evening business trains on the eastern section ran practically to time. The new apparatus in the electric signal box controlling all the lines south of London Bridge worked smoothly.

Trans-Pyreneen Railway.—COMPLETION CEREMONY.—The Trans-Pyreneen Railway, which was completed by the official opening on July 18th of the 4.5-mile long Somport tunnel, will link France and Spain. The line runs through 14 tunnels and crosses the Gave six times by three metal bridges and three viaducts. The station of Bedous, on the French side, is at an altitude of 1,300 ft.; the highest point of the Somport tunnel is 4,000 ft.; the international station of Canfranc is 3,800 ft. above sea level. According to *The Times*, the gradient from Bedous to the summit is very sharp, and has necessitated corkscrew tunnels, one of which, above Urdos, is over a mile long, and electric locomotives will be used.

United States.—NEW YORK.—According to the *Electric Railway Journal*, electrification of all railroad lines in New York City and its suburbs, elimination of grade crossings at the intersection of railroads and main highways, and unified management and operation of railroad transportation in the environs of New York, are some of the outstanding needs cited in the report on "Transit and Transportation" prepared by the Regional Plan of New York and Its Environs as the result of six years' study, the second section of which was made public May 14th. Several plans are proposed in the report, including one for a new subway system for the exclusive handling of package freight, coal, building materials and waste products. This plan proposes the use of small cars of about 10-ton capacity, with demountable bodies which could be transferred from the subway chassis to motor truck chassis for short hauls on the street surface. The regional planning body does not indicate which of the proposals it considers most desirable, but definite recommendations on the subject will be contained in the regional plan itself, which is to be drafted next autumn.

Telegraph and Telephone Notes.

"Beam" Radio-Telegraphy.—CANADA-AUSTRALIA LINK.—A further important development in the use of the Marconi short-wave "beam" system for Imperial communication took place on June 16th, when the "beam" stations built for communication between Canada and Australia were officially opened for public service. Hitherto "beam" messages from England could be transmitted over two routes direct to Australia, one eastward over Northern Europe, Russia and China, and the other westward over the northern part of South America and the Pacific. With the opening of the Canada-Australia service a third route by which messages can be relayed through Canada was added to supplement the other two routes in case of need.

Reuter's agency explains that the messages travelled by the Canadian Marconis Co.'s "beam" circuit between Melbourne and Montreal, whence they were relayed by the short-wave system of the Radio Corporation of America to Washington; the Corporation thus now has a direct service from New York to Australia.

Colombia.—TELEPHONE OPERATORS' STRIKE.—A strike of the operators in the British-owned telephone service commenced last week, and, according to the *Daily Telegraph*, enough money to sustain the strikers was collected by public subscription within a few hours. The Mayor, on behalf of the municipality of Bogota, offered to purchase the telephone company, the managers of which were awaiting instructions from London.

East Africa.—RADIO-TELEGRAPH SERVICE.—The British Postmaster-General announced on June 15th that a direct radio-telegraph service had been inaugurated that day between England and Kenya and Uganda.

The British East African Broadcasting Corporation owns and operates the service from the African end.

International Telephony.—ANGLO-PORTUGUESE SERVICE.—The British Postmaster-General announced on June 12th the inauguration of a service from all parts of Britain to Portugal, *via* Madrid, restricted to Lisbon calls at present.

HISPANO-DUTCH SERVICE.—Direct telephone communication between Spain and Holland was formally opened on June 15th. Conversations were exchanged between General Primo de Rivera and Jonkheer van Blokland and between the Postmasters-General of the two countries.—*Reuter* (The Hague).

South America.—RADIO-TELEPHONY.—It is announced that the International Telephone and Telegraph Corporation will shortly establish a wireless-telephone service between Spain, Mexico, and a number of South American countries, including Chili, Argentina, and Brazil.—*Reuter* (New York).

Radio Notes.

East Africa.—BROADCASTING IN KENYA.—The first broadcasting station in East Africa was opened on June 14th, states the Commissioner of H.M. Eastern African Dependencies Trade and Information Office. The new station is situated in Kenya, a few miles out of Nairobi, the capital of the colony, and the enterprise was locally promoted and financed. Lord Delamere is chairman of the British East African Broadcasting Co., which is under the management of Commander L. Mansfield-Robertson, a well-known naval airman. Kenya is the third British colony to possess a short-wave broadcasting station.

Station Frequency.—MEASUREMENT CHARTS.—In its June 15th issue, *World-Radio* published a useful chart of the measured frequencies of the majority of the European broadcasting stations using the medium (200 to 600 metres) waveband of from 1,500 to 500 kilohertz (1 kilohertz=1 kilocycle per second) for the month of May. It is a reproduction of the official chart of the Brussels frequency-checking station of the Union Internationale de Radiophonie, and our contemporary hopes to publish during the third week of each month a similar record for the previous month. The apparatus used at Brussels permits of the actual measurement of frequency to one part in 10,000, whereas limitations of space in reproduction reduce the accuracy with which the chart may be read to one part in 1,000. It is a graphical record of the wave-repartition "Plan de Genève," which was put in operation on November 14th, 1926, and indicates how stations have varied during the month from the frequencies allotted to them. It is claimed that the chart shows the Geneva plan to have been successful in at least 80 per cent. of the cases.

The B.B.C.—FIRST YEAR'S WORK.—The report of the governors of the British Broadcasting Corporation on its first year's work was issued last week. It deals with the calendar year 1927, for one of the consequences of Government administration is that such documents are produced by the leisurely methods of H.M. Stationery Office. The total income was £901,626, of which £800,959 was licence revenue and £93,686 was derived from publications. The total expenditure was £773,289; programmes cost £489,728; maintenance of plant, power, salaries, &c., cost £131,036; administration salaries and expenses amounted to £50,904, and governors' fees to £6,100. Of the 68,000 hours of transmission the percentage of breakdown was 0.03. At the end of the year licences numbered 2,395,174 (including 12,594 free for blind people), an increase of 217,000, while 4,000 schools listened to the London (2LO) and Daventry (5XX) transmissions, double the number for the previous year. The stations were equipped early in the year with special devices to enable them to adhere to the frequencies allotted under international agreement, and the listening post at Keston, Kent, was used as a checking centre for the stability of frequencies by means of very accurate wavemetres. The quality of transmission improved as a result of experimental work on transformers, lines, transmitters, and amplifiers. Experimental work on acoustics gave rise to a novel method of studio construction, whereby artificial echo was introduced, which considerably improved the quality of music broadcast. The new form of microphone introduced in the London studios in 1926 was put into operation for all outside broadcasting work. Successful connections were made by undersea cable with Continental stations. Considerable research on microphones was carried on, and it is expected that newer and better types will soon be available. A reserve of £100,000 for the regional scheme has been appropriated from revenue.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Argentina.—BUENOS AIRES.—July 19th. National Sanitation Works Department. 24 electric sewage pumping plants. (A.X. 6389.)*

Atherton.—June 28th. Urban District Council. Two 130-kVA transformers. (June 8th.)

Australia.—MELBOURNE.—August 14th. Postmaster-General's Department. Junction apparatus for manual exchanges. (B.X. 4486.)*

Barnstaple.—July 13th. Corporation. One 100-kW Diesel oil engine with d.c. generator, one storage battery 240 cells, l.p. switchgear, and about 14 miles l.p. cables. (See this issue.)

Birmingham.—June 28th. Board of Guardians. Electric lighting work in connection with the modernisation of Western Road House. Specification, £2 2s., from Mr. C. F. Beech, clerk to the Guardians, Union Offices, Edmund Street, Birmingham.

Croydon.—July 3rd. Electrical Department. 18,000 tons of coal for chain-grate mechanical stokers. (See this issue.)

Ecuador. — GUAYAQUIL. — July 31st. Government of Ecuador One 5-ton (metric) and one 10-ton (metric) electrically-operated portal cranes. (A.X. 6387.)*

Edinburgh.—June 25th. Education Authority. Complete electrical installation for four schools and janitors' houses. Schedules from offices of the Authority.

Erith.—June 25th. Electricity Department. H.p. cables. (June 15th.)

Greenock.—July 2nd. Trustees of the Port and Harbours. Electrification of the Gravel pumping station, altering steam pumps to electric drive or, alternatively, two electrically-driven dock pumps, electrically-driven hydraulic pumps, &c. Specifications (42s.) from Mr. A. Leitch, consulting engineer, 65, Bath Street, Glasgow.

India.—SIMLA.—July 2nd. India Stores Department. Equipment for the Sumera hydro-electric pumping and power supply scheme. (B.X. 4483.)*
July 3rd. 180 miles electric cable. (See this issue.)

Irish Free State.—DUBLIN.—July 18th. Electricity Supply Board. Transformer stations, switchgear, and transformers. (See this issue.)

Kirkcaldy.—The Finance and Property Committee of the Fife County Council is inviting tenders for the installation of electric lighting in the Sheriff Court.

Leeds.—June 28th. Libraries and Arts Committee. Alterations to the electric lighting installation in the Lending Department of the Central Library. Specifications from Mr. W. T. Lancashire, city engineer, Municipal Buildings, Leeds.

London.—LONDON COUNTY COUNCIL.—July 9th. Soot extraction plant for the Greenwich power station. (June 15th.)
June 26th. Electric lighting installation at the Dockhead Fire Brigade Station, S.E. (about 80 lighting points). (June 15th.)
BETHNAL GREEN.—June 26th. Board of Guardians. Internal telephone system for the administrative offices in Bishop's Road. E. (June 15th.)
METROPOLITAN WATER BOARD.—June 25th. Six or 12 months' supply of electric lamps. Specifications from the Chief Engineer, 173, Rosebery Avenue, E.C.1.
H.M. OFFICE OF WORKS.—July 6th. Supply of mechanical and electrical engineering labour in the Manchester district during a period of three years. (See this issue.)
LONDON AND HOME COUNTIES JOINT ELECTRICITY AUTHORITY.—July 12th. Transmission lines from the Kingston-on-Thames B.C. generating station to the Hersham sub-station of the Walton-on-Thames U.D.C. (See this issue.)

Manchester.—June 30th. Public Health Committee. Supply and erection of automatically-controlled electrical refrigerating plant, Baguley Sanatorium, near Altrincham. Specification from Sanatorium.
July 3rd. Electricity Committee. Twelve months' supply of 6,600-V cubicle type sub-station switchgear. (See this issue.)

Newport (Mon.).—June 30th. Electricity Department. Three kiosk transformer sub-stations. (June 15th.)

New Mill.—June 29th. Urban District Council. Extension of overhead electricity supply mains. (See this issue.)

New Zealand.—WELLINGTON.—August 14th. Public Works Department. 50-kV switchgear and steelwork for Arapuni electric power scheme. (B.X. 4477.)*

Nottingham.—July 3rd. Electricity Committee. General stores for 12 months. (June 15th.)

Plymouth.—June 27th. Electricity Department. Stoneware conduits. (June 15th.)

South Africa.—JOHANNESBURG.—July 26th. South African Railways and Harbours. Two 25-ton, six 10-ton, and two 2-ton electrically-driven overhead travelling cranes. (A.X. 6347.)*
August 2nd. Electrically-driven concrete mixing plant, self-propelling gantry, &c. (A.X. 6441.)*
July 12th. 120-kV transformers and truck-type switchgear. (B.X. 4479.)*
July 19th. Electric incandescent lamps. (B.X. 4487.)*
August 9th. Six electrically-driven overhead travelling cranes. (A.X. 6409.)*
KYSNA.—July 6th. Municipal Council. Installation of an electric lighting and power system. (B.X. 4493.)*

Stone.—July 3rd. Urban District Council. E.h.p. and l.p. cable and l.p. overhead distribution and service lines. (June 15th.)

Sunderland.—July 9th. Electricity Department. Cable, r.i. wire, consumers' meters, and incandescent lamps for 12 months. (June 8th.)

Swindon.—July 7th. Electricity Department. Steam, exhaust, water and other pipework, valves, tanks, evaporators, &c. (June 15th.)

Uruguay.—MONTEVIDEO.—August 10th. 20 equipments for transformer sub-stations, indoor type (6,600/220 V). (B.X. 4505.)*

West Riding.—Installation of electric lighting at the Drighlington and Emley Councils Schools. Particulars from Mr. B. Sheard, West Riding Education Offices, 8, St. John's North, Wakefield.

Wrexham.—June 26th. Board of Guardians. Electric lighting installation at the Institution. Mr. J. Bagnall Bury, clerk, 23, Chester Street.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Barnsley.—Electricity Committtee. Recommended:—
Water-tube boiler, with superheater, economiser, induced-draught plant and automatic stokers (£5,800).—Babcock & Wilcox, Ltd.

Burton-on-Trent.—Electricity Committee. Accepted:—
Electrical work in connection with the change over in St. Paul's Square district (£1,950).—British Insulated Cables, Ltd.

Bradford.—Tramways Committee. Accepted:—
Six 36-seater railless electric trolley vehicles (£8,580).—English Electric Co., Ltd.

Electricity Committee. Accepted:—
Circulating water valves.—J. Blakeborough & Sons, Ltd.
Circulating water pipes at Valley Road power station.—Stanton Ironworks Co., Ltd.
Circulating water pump.—Mather & Platt, Ltd.

Fire Brigade Committtee. Accepted:—
Electric light installation at central fire station residences (£185).—Mr. J. Carter.

Caistor.—Board of Guardians. Accepted:—
Renewal of batteries at the Institution (£150).—Hart Accumulator Co., Ltd.

Gravesend.—Town Council. Accepted:—
Two kiosks for the Perry Street electricity supply (£370).—Yorkshire Switchgear & Engineering Co., Ltd.

Greenock.—Renfrewshire Education Authority.
Electrical installation at New High School (£812).—Kennedy, Stark & Co.

Grimsby.—Electricity Committee. Accepted:—
Boiler house plant (£44,657).—Clarke, Chapman & Co., Ltd.

Hastings.—Electricity Committee. Accepted:—
L.p. overhead lines for the supply of out-districts (£8,309). W. T. Glover & Co., Ltd.
Extensions to evaporating plant at power station (£1,516). —P. & B. Evaporators, Ltd.
Reinforced concrete cooling tank at power station (£2,135). —J. & W. Stewart.
Dismantling and re-erecting original cooling towers (£920). —Premier Cooler & Engineering Co., Ltd.
Structural steelwork for premises at power station (£174). —Pierson & Co., Ltd.
500-kVA transformer (£374).—Ferranti, Ltd.

Leyland.—Leyland Motors, Ltd. Accepted:—
800 patent valve oil feeders.—Joseph Kaye & Sons, Ltd.

Liverpool.—Corporation. Accepted:—
X-ray equipment for the Fazakerley sanitorium (£216), Victor X-ray Corporation, Ltd.; for the Broadgreen sanatorium (£557), Schall & Co., Ltd.

London.—ADMIRALTY.
Admiralty pattern switches.—Edison Swan Electric Co., Ltd.

AIR MINISTRY.
Reconditioning accumulators.—Edison Swan Electric Co., Ltd.

LONDON COUNTY COUNCIL.—Accepted:—
V.i.r. cables.—British Driver-Harris Co., Ltd.

LONDON & NORTH-EASTERN RAILWAY CO.—Accepted:—
Ten months' supply of train lighting lamps.—General Electric Co., Ltd.

ST. MARYLEBONE.—Electric Supply Committee.
Cables for 12 months.—Enfield Cable Works, Ltd., British Insulated Cables, Ltd., and Callender's Cable & Construction Co., Ltd. (Recommended.)

SHOREDITCH.—Lighting Committee.
Cable for mains extension.—W. T. Glover & Co., Ltd. (Recommended.)

Oldham.—Education Committee. Accepted:—
Electric light installation at Northmoor and Hathershaw schools.—Frank Wall & Co.

Portsmouth.—Electricity Committee.
E.h.p switchgear (£3,072); l.p. switchgear (£1,155).—English Electric Co., Ltd. (Accepted.)
E.h.p. switchgear (£3,192).—General Electric Co., Ltd. (Recommended.)

Spalding.—Urban Council. Accepted:—
Connecting private premises to the distributing main at Crowland (35s. each); cable for the supply to Crowland (£1,716); underground cable to supply a sugar factory and overhead steel wire (£380).—John Collier & Co., Ltd.

Sutton Coldfield.—Corporation. Accepted:—
One 300-kW convertor set for the Wylde Green sub-station (£3,341).—General Electric Co., Ltd.

Swindon.—Town Council. Accepted:—
H.p. feeder, l.p. pilot, and other cables (£28,849).—Standard Telephones & Cables, Ltd.

Troon.—
Electrical work at the new Marr College.—William Dow and Sons, Ltd.

Wakefield.—Education Committee. Accepted:—
Electrical equipment for technical college—
Electrical machines.—Crompton-Parkinson, Ltd.
Transformers.—Cattell Electric Mfg. Co.
Air compressor and tanks.—Reavell & Co., Ltd.
Air measuring instruments.—A. Macklow Smith.

Electricity Committee. Accepted:—
Electrical work at Manygates Council School (£575).—W. Robb, Ltd.

Watford.—Electricity Committee. Recommended:—
Switchgear (£1,755); 250-kVA transformer (£150).—Metropolitan-Vickers Electrical Co., Ltd.

Weymouth.—Electricity Committee. Accepted:—
Cables for the Radipole Spa Estate. Schedule rates.—Johnson & Phillips, Ltd.

Forthcoming Events.

Physical Society.—Friday, June 22nd. Imperial College of Science, South Kensington, S.W. 5 p.m. Ordinary meeting.

Association of Mining Electrical Engineers.—Friday, June 22nd. Buxton. Annual meeting.

British Electrical Refrigeration Campaign.—June 8th to June 25th.

Institution of Mechanical Engineers.—June 25th to June 29th. Southampton. Summer meeting.

Institution of Electrical Engineers.—June 25th-30th. Glasgow. Summer meeting.

Royal Society of Arts.—Wednesday, June 27th. John Street, Adelphi, W.C. 4 p.m. Annual general meeting.

Electrical Contractors' Association.—July 4th-6th. Cheltenham. Annual conference.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

SELFIX junction boxes for lead-covered cable.

A new rectifier known as the CUPRIC OXIDE PLATE RECTIFIER.

AUTO-MAID vacuum cleaners.

UTILITY potato peeling machine.

A patent bowl clip (Reg. No. 167,032).

Notes.

E.A.W. Activities.

The last visit of the season, organised by the Glasgow Branch of the Electrical Association for Women, took place on June 5th, when the factory and works of the Scottish Co-operative Wholesale Society at Shieldhall, Glasgow, were visited.

Members of the Birmingham and Midlands Branch of the Electrical Association for Women listened to an interesting lecture by Dr. Alexander Bryce, M.D., on "Sunlight," artificial and natural—in health and disease—at Moseley, on June 7th.

Television.

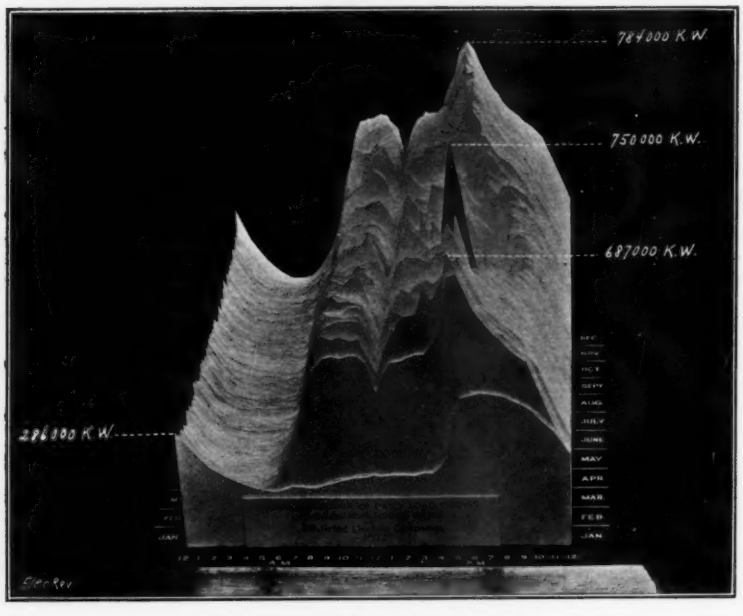
Sir W. Mitchell-Thomson (Postmaster-General), replying to Mr. L'Estrange Malone, in the House of Commons recently, said that technical officers of his Department had witnessed four demonstrations of television, three in this country and the fourth in the United States a few weeks ago. The company most active in the matter in this country agreed in September last to give his officers a further demonstration, but so far this promise had not been fulfilled. He had seen a statement in the Press that television tests were recently conducted by an American broadcasting station, but that after a week of tests no one had reported reception of the moving images.

Extensions at Clacton.

To meet the increasing demand for electricity in the surrounding rural areas and anticipated further local demands, Mr. George Broadhurst, A.M.I.E.E., the electrical engineer to the Clacton Urban District Council, last year drew up a scheme providing for the installation of two additional Diesel oil engines coupled to 750-kW, 6,600-volt, 50-cycle, 3-phase alternators, and suitable converting plant, together with the necessary switchgear for controlling the a.c. supply. Previously the station had been entirely d.c., 3-wire. The a.c. supply is stepped up to 11,000 volts by two 250-kVA, 3-phase, 50-cycle transformers. The converting plant, which was installed by Messrs. Crompton-Parkinson, Ltd., consists of a 500-kW and a 250-kW, 6-phase rotaries, both designed to operate on 6,600/6,680 volts, 50 cycles, 3-phase. The rotaries are arranged for reactance control and for starting by means of pony motors from the a.c. side and by resistance when starting from the d.c. side. The machines are self-synchronising in starting from the a.c. side by means of the Crompton-Parkinson patented method of starting. The rotaries are suitable for inverted operation, and it is interesting to note that the plant is at present running inverted eighteen hours out of the twenty-four, and giving every satisfaction. The switchgear, including the 11,000-volt feeder equipment, was all supplied by Messrs. Crompton-Parkinson, and consists of cubicles of their latest design—in addition to the d.c. equipment. There are ten cubicles in all, in addition to a 2-panel d.c. board. The starting panels and exciter pillars are arranged for floor mounting. The a.c. supply at present is available at Little Holland, where a transformer sub-station has been erected.

Variations in Load Graphically Recorded.

Variations in the load carried by the electricity generating stations of the New York Edison Company and its affiliated companies, from hour to hour, day to day, and month to month throughout the entire year 1927 are graphically illustrated by a three-dimensional block resembling an ice mountain, prepared under the direction of Mr. W. H. Lawrence, chief operating engineer of the company, and illustrated herewith. The fluctuations in the load for each day in the year



Graphical Records of Load Variation.

were plotted on extremely thin boards, which were then carved out by jig-saw, and placed against each other in chronological order. The result gives one the impression of a cross-section of the Alps, but its usefulness as a chart of the trend of New York's use of electricity may be seen. The width represents the 24-hour day, the depth the 365 days of the year divided into the twelve calendar months, and the height represents the hundreds of thousands of kilowatts of energy being demanded by the people of the city at every moment of the year. It is possible, therefore, to compare at a glance the load at any hour of any day with any hour of any other of the 365 days of the year. So closely related is the consumption of electricity to the life of the city that by looking at the chart one can easily reconstruct the activities of the people through the days and months of the year: beginning at midnight, for example, on any day one observes that the demand for energy drops until about 5 a.m., when practically all the city is asleep, and the demand is at a minimum. Then, as the city awakens, the demand increases until between 8 and 9 a.m., when it reaches a maximum that it maintains through the morning. The cessation of work for the luncheon hour is shown by the crevice in each day's demand from 12 noon to 1 p.m.; at 12.30 p.m. the bottom of the crevice is reached. From then on the demand steadily increases until about 5 p.m., when it reaches its highest point for the day; at that time places of business have not yet ceased work and, in addition, domestic light is beginning to be switched on. With the cessation of business for the day the demand drops rapidly.

Many other interesting things are observable from a study of this pictorial chart: on every seventh day, for instance, there is a higher peak at midnight than on other days. Saturday night, when so great a section of the city's population visits theatres and indulges in other social activities until a comparatively late hour, is shown by the trend of the curve. On cloudy, or stormy, days the dropping off of the day-time load is not so rapid as on clear days, for the reason that additional light is needed in the afternoon and remains in use during the evening. The approach of longer days in the spring is also recorded by the retarding of the hour when the evening peak load comes on; with the advent of "daylight saving" the peak is still further retarded. The figures on the chart show the load carried at various times during the year: 286,000 kilowatts, for example, was the demand at twelve o'clock midnight on New Year's Eve; 687,000 kW was the five o'clock demand on January 4th, the difference between the two illustrating the wide variation of the demand on the New York Edison system. The dark peak of 750,000 kW was inserted to represent the demand that would follow a storm such as that which occurred on June 20th, 1919, which came upon New York suddenly, and occasioned an almost vertical increase in the demand for energy. The peak of 784,000 kW was the greatest demand of the entire year, and occurred at 5 p.m. on December 13th. The graph for the first day, shown at the front of the chart, with a very low demand up to 5 p.m., indicates that there was practically no commercial activity on New Year's day.

Red Light for Fog.

A brilliant red arc light that makes use of neon gas, and which can shine through thick fog, has been developed at the research laboratory of the General Electric Company (U.S.A.). The new lamp is the result of the work of Dr. Clifton G. Found, in collaboration with J. D. Forney, of the Cooper-Hewitt Electric Company, and was recently demonstrated by them to engineers.

Airplane landing fields will probably be among the first to make use of the lamp, for by outlining the fields with them aviators flying above through fog will be enabled to make a safe landing. Docks in harbours may also be marked with the lamp. According to Dr Found, the light has been tested for this use; "Observations from boats during fog," he says, "have shown that it was possible to pick up the red neon light before any of the other lights in the same vicinity were observed."

Earlier forms of neon tubes, which give the characteristic red neon light that is now so common to advertising signs, suffer from what is called the "cathode drop"—the great difference in voltage between the electrode and the gas. On account of it, also, tubes must be operated with a high voltage, and must be made quite long in order to be efficient. Another disagreeable effect is that the gas gradually disappears.

In the new tube of Dr. Found and Mr. Forney the cathode is heated by means of an additional electric circuit. This causes it to give off the electrons which cause the neon gas to glow, but without the high voltages that are needed in the older tubes. By such means an extremely efficient source of brilliant red light can be obtained. Another possible use of the lamp is in photography, especially in colours. The mercury-vapour lamp, which gives a characteristically violet-coloured light, has often been used for ordinary photography, but the unnatural pallor which it causes is a disadvantage. By combining the neon light with the mercury-vapour lamp, the former supplies the red rays which are lacking in the latter, and the result is a good approximation to white light.—*Science.*

Large Turbo-Alternator Set.

The accompanying illustration depicts the low-pressure-turbine cylinder of the 160,000-kW turbo-generator set which the Brown-Boveri Company is supplying for the United Electric Light & Power Co. of New York. A large portion of this set has been completed, and the balance is expected

Casting for 85,000-kW L.P. Turbine.

to be finished very shortly. It will be recalled that the turbine is a cross-compound one, and comprises two shafts capable of delivering a total of 160,000 kW. The high-pressure set is designed for 75,000 kW at 1,800 r.p.m., and the low-pressure one will deliver 85,000 kW at 1,200 r.p.m. The weight of the complete plant will be 1,150 tons, and the weight of the low-pressure cylinder shown in the photograph is 340 tons.

German Locomotives.

Members of the Association of English Locomotive Engineers, who are touring in Germany, have paid a visit to the locomotive works of the Allgemeine Elektricitats Gesellschaft at Hennigsdorf. About 100 of the visitors inspected the modern equipment for the manufacture and assembling of electric and steam locomotives, says the *Financial Times*, which explains that at the invitation of the German State Railways, the English engineers travelled a considerable distance in a train drawn by the A.E.G.'s coal-dust locomotive, the working of which they were able to study.

B.E.S.A. Publication.

The British Engineering Standards Association announces the publication of a British Standard Specification for Fire Hose Couplings No. 336-1928. This gives the necessary dimensional particulars for three types of couplings, namely, the round thread, the V thread, and the Morris instantaneous type. The sizes of the two former are 2¼, 2½, and 2¾, and for the latter 2¼ and 2½ in. diameter with interchangeability. Copies of the specification may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London, S.W.1, price 2s. 2d., post free

Terrestrial Magnetism.

The report of the Astronomer Royal, presented at the annual visitation of the Royal Observatory, Greenwich, on June 2nd, states that the results of the magnetic observations (now made at Abinger) for the last three years are as follows:—

	Decl. W.	Hor. Force.	Vert. Force.	Dip.
1925	13° 22.7′	0.18597	0.42946	66° 35.1′
1926	13 10.4	0.18581	0.42947	66 36.3
1927	12 58.4	0.18575	0.42932	66 36.2

Ships' Radio Apparatus.

Differences of opinion as to the types of ship which should be required to carry radio apparatus were referred to at the International Shipping Conference in London last week, says the *Daily Telegraph*.

Mr. W. A. Souter, director of the Baltic and International Maritime Conference, said that the Wireless Committee had met and tried to bridge over difficulties which existed, but it was not successful. At his suggestion the conference referred back the committee's report, giving the executive authority to act when the reconsidered report was received.

Mr. A. P. Moller (Denmark) said that there was a difference of opinion with regard to the value of enforcing the use of wireless apparatus on a great number of slow cargo steamers in respect of the possibility of saving life.

Fatality.

While painting a pole that carries wires conveying electricity from Bullcross Colliery to the Markham Main Colliery, Doncaster, Oscar Barber, a labourer, caught hold of the top wire and received a fatal electric shock.

Rural Electrification in Belgium.

An official return lately issued shows that out of 2,668 small towns and villages in Belgium with a total population of 7,874,000, some 1,998 have now supplies of electricity available for lighting and power purposes. Thus, 74.9 per cent. of the communes and 91.5 per cent. of the population are being supplied, leaving only 25.1 per cent. and 8.5 per cent., respectively, still to be linked up to central power station distribution systems.

Wayleave Agreements.

The Overhead Lines Association has sent us a form of notice and consent for wayleaves which it has submitted to the Electricity Commissioners for their consideration; this is the outcome of inquiries conducted by the Association since November 11th, 1927, and of two open meetings at which wayleave forms have been discussed.

A Consulting Engineers' Congress.

The fourth international congress of consulting engineers is to be held at Amsterdam in September next (12th to 15th). Particulars can be obtained from the secretary of the Organisation Committee, Mr. V. W. van Gogh, 125, Heerengracht, Amsterdam.

Electricity Supply Regulations.

Regulations have been prescribed by the Electricity Commissioners under Section 4 of the Electric Lighting Act, 1888 (El.C. 12 A; H.M. Stationery Office, price 3d. net). They incorporate the revised overhead line regulations with the "general" regulations and those relating to the connection of circuits with earth.

The Fuel Conference, 1928.

We have received a list of the British papers to be presented at the Fuel Conference in September, from the secretaries, to whom applications for membership forms should be addressed as soon as possible (World Power Conference, 36, Kingsway, London, W.C.2).

A Golfing Competition.

A combined meeting was held on June 18th, at Walmley Golf Club, of the Birmingham Electrical Golfing Society and the Birmingham Electrical Club. The trades cup was competed for by the Society and other prizes given by the Birmingham Electrical Club. Messrs. F. Boyes and J. Hamilton each had a net score of 72; the best round was that of Mr. W. A. Millinger, 84, net 77.

Scholarships for Science.

The Board of Education offers annually a number of Royal Scholarships and Free Studentships tenable at the Imperial College of Science and Technology, London. The awards are determined on the results of the science scholarships examination which is held by the Board each year in the spring. They are open to British subjects of either sex, and there is at present no age limit. Candidates may compete in any of the following groups: engineering, physics, chemistry, biology, and geology. The examination for 1929 begins on April 24th. The time table of the various subjects of examination is included in the syllabus. Candidates are required to make application on the prescribed form (which may be obtained from the Board) not later than January 15th, 1929. Applications for admission to the competition for the Whitworth Scholarships in 1929 must be made on the prescribed form (to be obtained from the Board) not later than January 15th, 1929.

The Engineers' Club (London).

The Engineers' Club, at a corner of Coventry Street (close to Piccadilly Circus), for a good many years has been recognised as an agreeable resort for those concerned directly or indirectly with engineering. Like most clubs, however, the Engineers' Club has been subject to vicissitudes, which not long ago assumed a somewhat threatening appearance. A very energetic new chairman, with an indefatigable new secretary, however, soon steered the club into quieter waters, and on June 5th a celebration dinner was held to mark the entry of the Club into a new, and, it is confidently anticipated, a long period of renewed prosperity. Members of the Club owe much to the chairman, Mr. G. W. Collins, J.P., and Mr. W. Diment, the hon. secretary, in connection with their arduous labours in the interests of the Club, and these gentlemen may be congratulated on having brought their task to a satisfactory conclusion. This sense of obligation was strongly indicated on the occasion of the dinner, which was enlivened by the assistance of well-known artistes, including the well-known entertainer, Mr. Arthur Prince, also an engineer and a member of the Club, in a lengthy and interesting musical programme.

The Kipling Society.

The annual luncheon of the Kipling Society was held at Princes Galleries, Piccadilly, on June 5th. Major-General L. C. Dunsterville ("Stalky") presided, and Lord Birkenhead paid a tribute to Kipling's genius. The hon. secretary (and original founder) of the Society is Mr. J. H. C. Brooking, M.I.E.E., 1, Vanbrugh West, Blackheath, S.E.

Appointments Vacant.

Technical officer (£361) for the Royal Aircraft Establishment, South Farnborough. Deputy borough electrical engineer (£375) for the Stoke Newington Borough Council Electricity Department. Junior shift engineer (70s.), for the Horsham U.D.C. Electricity Works. (See our advertisement pages to-day.)

The 1926 Act.

Whilst going to press we have received the following letter from Mr. F. W. Purse, past-president of the I.M.E.A.:—"I feel I must be allowed to correct your statement in last week's issue in connection with this Act that the I.M.E.A. were content to pass pious resolutions. As chairman of its Law and Emergency Committee, I am in a position to say that strenuous and continuous efforts were made by the Association to correct the many apparent defects, but the Bill was handed to the Attorney-General as his brief, and he steamrollered it through Parliament, defying and decrying all criticism. Public opinion was also muzzled, as the daily Press refused to publish any views in opposition to the Bill."

I.E.E. (Mersey Centre) Golf Competition.

The golf competition in aid of the I.E.E. Benevolent Fund, for which Mr. G. P. Dennis, M.I.E.E., presented a handsome trophy, will be held on Wednesday, July 18th, on the links of the Woolton Golf Club. The tournament will be a bogey competition under handicap, and will be open to members and their friends. The player (being a member of the I.E.E.) who returns the best net score against bogey will receive the G. P. Dennis trophy and replica, the trophy to be held by the winner for one year. If the best net score is returned by a non-member of the I.E.E. he will be awarded a prize. Prizes will be awarded under medal play rules to competitors in two classes, handicap 13 or under, and handicap 14 or over, respectively, and there will be an optional sweepstake of 2s. 6d. A putting competition will be arranged, and a two-ball foursome competition will be played for two prizes under medal play rules. The net proceeds will be handed over to the I.E.E. Benevolent Fund. It is proposed to hold an informal dinner and smoking concert following the competition at the Golf Club. Those wishing to compete should write to the hon. secretary, Mr. Oscar Waygood, without delay. The prizes have been presented by British Insulated Cables, Ltd., the British Thomson-Houston Co., Ltd., the English Electric Co., Ltd., the General Electric Co., Ltd., and Metropolitan-Vickers Electrical Co., Ltd.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. W. E. RICHARDSON, rolling stock superintendent to the Doncaster Corporation Tramways Department, has been appointed chief electrical engineer and tramway manager to the Aberdare Urban District Council. Mr. Richardson was formerly assistant engineer at the Chelmsford electricity works.

Sir T. O. CALLENDER, managing director of Callender's Cable and Construction Co., has been appointed deputy chairman of that company.

Mr. THOMAS TOMLINSON, B.A.I., M.I.C.E.I., M.I.E.E., who, as already stated here, was recently presented by his colleagues in Ireland with an illuminated testimonial bearing many interesting signatures, a case of pipes and a cheque, sailed from Southampton on Wednesday last week to join members of his

Mr. Thomas Tomlinson, M.I.E.E.,
who has sailed for Australia.

family in Australia, some distance north of Sydney. He has carried with him the hearty good wishes of a host of electrical friends who predict for him many years of health and happiness on the successful farm of one of his sons. As we engaged in a parting handclasp Mr. Tomlinson with characteristic mirth predicted that in his next photograph he would be seen driving a tractor.

It is reported in the Yorkshire Press that Mr. W. CHAMBERLAIN, the general manager of the Leeds Corporation tramways, has been offered the tramway managership at Belfast. The salary is said to be £2,250, as compared with £1,500 which he receives at Leeds.

The Torquay Town Council has decided that the salary of the electrical engineer (Mr. H. F. G. WOODS) for the year ending March 31st last, and for the year commencing April 1st last, shall be on the basis of 12,150,000 units sold, making the figure £1,060.

Mr. E. G. BATT, of the General Electric Co., Ltd., was married on June 7th to Mrs. G. M. D. Morgan. His new address is 25a, Kenilworth Court, S.W.15.

The *Daily Telegraph* states that Mr. F. J. HARLOW, principal of the Wigan Mining and Technical College, has been appointed principal of the Chelsea Polytechnic, in succession to Mr. Sidney Skinner. "During the war Mr. Harlow was in charge of the War Office department which dealt with the supply of X-ray and electro-medical equipment. Later he was principal of the Blackburn Municipal Technical College."

Mr. H. HOWARD HUMPHREYS, M.Inst.C.E., M.I.Mech.E., has been elected chairman of the Committee of the Association of Consulting Engineers (Inc.) for the ensuing year.

The Stockport Electricity Committee has resolved that Mr. G. H. OLDROYD, station engineer, be appointed deputy electrical engineer for one year on probation at his present salary.

Obituary.—MR. H. G. BABB.—Mr. Harold Godwin Babb, A.I.E.E., who was sectional engineer with the Clyde Valley Electrical Power Co., Glasgow, at its Hamilton station, met with an accident at Wishaw on May 18th, and was so seriously injured that his life was despaired of. He was rendered unconscious, and lingered till Saturday, June 9th, when, we regret to learn, he succumbed to his injuries. He was the son of Mr. H. C. Babb, manager of the Lothians Electric Power Co., and the Musselburgh & District Electric Light and Traction Co., Ltd., and was born at Dartmouth. He was educated at the Royal High School, Edinburgh, articled with Messrs. Buchan & Partners, consulting electrical engineers, Edinburgh, and became a pupil in the works of Messrs. Bruce Peebles & Co. He had experience in the laying of electric mains with the Lothians Electric Power Co. prior to his going to the Clyde Valley Electric Power Co. Mr. Babb assisted in coastguard duty during the Great War. He was also assistant scoutmaster for Musselburgh, and scoutmaster at Wallyford. Mr. Babb is survived by a young widow and baby boy, with whom, as well as with the father and mother of the deceased gentleman, much sympathy has been expressed.

MR. W. B. O. STEWART.—The death occurred at Ouchy, Switzerland, on June 15th, of Mr. Walter Bowerbank Orpen Stewart, late of the Eastern Extension, &c., Telegraph Co., Ltd.

Will.—The late Mr. GEORGE OFFOR left £1,278 gross and £176 net personalty.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Radofone (1928). Ltd.—Private company. Registered June 9th. Capital, £100 in 400 deferred ordinary shares of 5s. each. Objects: To enter into a contract with G. D. Le Lievre and L. W. Murkham for the purchase of their joint venture relating to wireless and gramophone instruments, and to take over all or any assets and liabilities in connection therewith, including patents and the trade mark "Radofone." The first directors are: G. D. Le Lievre, 8, Beverstone Road, Brixton Hill, S.W.2, and L. W. Murkham, 14, Eleanor Road, E.15, electrical engineers. Secretary: C. T. Gillespie. Registered office: 22, Queen Street, Cheapside, E.C.4.

Ruskin Accumulator Service, Ltd.—Private company. Registered June 9th. Capital, £100 in 1s. shares. Objects: To carry on the business of electrical, mechanical, radio and television engineers, manufacturing chemists, manufacturers of and dealers in chemicals and electrical and radio material and fittings, gramophones and gramophone cabinets, &c. The permanent governing directors are: G. G. Portch, 111, Queen's Road, Buckhurst Hill, and H. G. Woodgate, 103, Pembury Road, Tottenham, N.17, electrical engineers. Registered office: 680, High Road, Tottenham, N.17.

Charles Payne, Ltd.—Private company. Registered June 9th. Capital, £1,500 in £1 shares. Objects: To acquire the business of an electrical engineer and contractor and wireless and hardware dealer now carried on in Coventry as "Chas. Payne." The permanent directors are: C. Payne and Mrs. Laura Payne, both of 26, Earl Street, Coventry. Qualification: £50 shares. Solicitor: J. Arch, Halifax Chambers, Warwick Row, Coventry.

Electronos. Ltd.—Private company. Registered June 13th. Capital, £1,500 in £1 shares (750 7 per cent. preference and participating and 750 ordinary). Objects: To carry on the business of manufacturers of electric and other signs, electricians, engineers, &c. The first directors are:—C. T. Haw-

tree, 13, Parliament Hill Mansions, Highgate, N.W., manufacturers' agent; W. E. Thomson, 118, Long Acre, W.C., manufacturers' agent; G. B. Scammell, 13, Parliament Hill Mansions, N.W.5, shipping agent. Secretary (*pro tem.*): E. McBean. Registered office: 24, Little Earl Street, W.1.

Edwards & Edwards, Ltd.—Private company. Registered June 12th, in Belfast. Capital, £1,000 in £1 shares. To carry on the business of engineers, electrical wholesalers, &c. The directors are:—C. K. Edwards, The Forge, Newforge, Malone Road, Belfast, mechanical engineer; C. H. Hardman, 101, Fitzroy Avenue, Belfast. Secretary: M. J. Clarke. Registered office: 16, Donegall Square South, Belfast.

Radio Electric Securities Corporation, Ltd.—Private company. Registered June 13th. Capital, £100 in £1 shares. Objects: To transact business as capitalists, promoters and financial and monetary agents, in England and elsewhere. The subscribers (each with one share) are:—G. E. Binsted, "Ripplevale," Rectory Road, Broadstairs, clerk; W. McEwen, 50, Hopedale Road, Charlton, S.E.7, clerk. The first directors are not named. Registered office: 317, High Holborn, W.C.1.

Carbo Electric Corporation, Ltd.—Private company. Registered June 14th. Capital, £100 in £1 shares. Objects: To carry on the business of bankers, capitalists, financiers, concessionaires, manufacturers and merchants, &c. The subscribers (each with one share) are: D. J. Hall and C. W. Foster, 18, Austin Friars, E.C.2, solicitors. The first directors are not named. Solicitors: Slaughter & May, 18, Austin Friars, E.C.

Neon Lights (1928), Ltd.—Private company. Registered June 14th. Capital, £2,000 in 1s. shares. Objects: To adopt agreements (1) between M. Georges Claude, E. James, and H. Marryat, (2) between the said E. James and H. Marryat, and (3) between Neon Lights (1923), Ltd., G. S. Groundwater, the liquidator thereof, and E. James, and to carry on the business of manufacturers of, agents for, dealers in and advertisement contractors for neon lamps or lights or any electrical, scientific, mechanical or other devices, &c. The subscribers (each with one share) are:—E. James, Hendon Hall Hotel, Hendon, N.W.4, C.A.; G. S. Groundwater, 77, Trinity Rise, Tulse Hill, S.W.2, C.A. The first directors are not named. Registered office: St. Lawrence House, Trump Street, King Street, E.C.2.

Funditor, Ltd.—Private company. Registered June 14th. Capital, £500 in £1 shares. Objects: To carry on business as manufacturers of and dealers in electric heating, lighting and power machines, apparatus and devices, &c. The directors are: J. M. Evans, 17, Hampstead Way, N.W. (director of Lamson Paragon Supply Co., Ltd.); E. G. Dixon, Hainault, The Avenue, Wanstead, E.11 (director of Victory Kidder Printing Machine Co., Ltd.). Registered office: Blackfriars House, New Bridge Street, E.C.4.

Excel Wireless Components, Ltd.—Private company. Registered June 14th. Capital, £250 in £1 shares (150 preference and 100 ordinary). To acquire the business of manufacturers of wireless sets and components carried on by F. Barratt and J. P. Smart, at 53, Abington Street, Northampton, as "Excel Radio Components." The permanent directors are:—F. Barratt, 52, Beech Avenue, Northampton: J. P. Smart, 7, Rothersthorpe Road, Northampton. Qualification: £10 shares. Registered office: 53, Abington Street, Northampton.

Official Returns of Electrical Companies.

Callington and District Electric Supply Co., Ltd.—Capital, £8,000 in £1 shares (increased from £5,000 on April 13th, 1928). Return dated March 30th, 1928. 5,000 shares taken up. £5,000 paid. Mortgages and charges: £1,000.

Flactophone Wireless, Ltd.—Capital, £1,000 in £1 shares. Return dated December 8th, 1927. 700 shares taken up. £700 paid. Mortgages and charges, nil.

N.E.S. (Bradford), Ltd.—Capital, £1,500 in £1 shares. Return dated March 23rd, 1928. 1,100 shares taken up. £900 paid, £200 considered as paid. Mortgages and charges, nil.

Hestavox, Ltd.—Capital, £5,000 in £1 shares. Return dated December 31st, 1927 (filed March 31st, 1928). 3,004 shares taken up. £3,004 paid. Mortgages and charges, nil.

Local Factors, Ltd. (formerly Traggoh Lamp Co., Ltd.).—Capital, £1,000 in £1 shares. Return dated December 31st, 1927 (filed March 12th, 1928). All shares taken up. £1,000 paid. Mortgages and charges: £500.

New Armature Co., Ltd.—Capital, £1,000 in £1 shares. Return dated January 31st, 1928. 745 shares taken up. £745 paid. Mortgages and charges, nil.

Attaix, Ltd.—Satisfaction in full (1) on May 7th, 1928, of charge dated November 3rd, 1926, securing all moneys due or to become due, and (2) on May 16th, 1928, of charge dated May 5th, 1927, securing £1,000.

George Black & Sons, Ltd. (in liquidation).—Two charges (1) on lands and buildings at Tweedmouth, and (2) on land with house and other erections thereon, both dated May 11th, 1928 (supplemental to memorandum of deposit date March 22nd, 1921) to secure £8,487 outstanding under that memorandum and all moneys due or to become due from the company to Barclay's Bank, Ltd.

F. E. Baker, Ltd.—C. J. Pain, 18, Low Pavement, Nottingham, ceased to act as receiver or manager on May 22nd, 1928.

General Battery Co., Ltd.—G. M. Chantrill, 1, The Grove, Golders Green, N.W.11, ceased to act as receiver or manager on May 31st, 1928.

Radio Service (London), Ltd.—Satisfaction to the extent of £125 on May 15th, 1928, of debenture dated July 25th, 1927, securing £2,750.

E. S. White & Co., Ltd.—Debenture dated May 29th, 1928, to secure £2,000, charged on land at Warrington, and the company's undertaking and other property, present and future, including uncalled capital. Holders: Branch Nominees, Ltd., 15, Bishopsgate, E.C.

Watford Electric and Manufacturing Co., Ltd.—Satisfaction to the extent of £500 on May 31st, 1928, of first debenture dated May 31st, 1923, securing £3,000. (Previously satisfied £2,000.)

Walsall Electrical Co., Ltd.—Capital, £20,620 in £1 shares. Return dated October 13th, 1927 (filed January 14th, 1928). 12,000 shares taken up. £10,000 paid. £2,000 considered as paid. Mortgages and charges nil.

W. P. T. Ltd.—Capital, £150 in £1 shares. Return dated December 31st, 1927 (filed March 8th, 1928). Two shares taken up. £2 paid. Mortgages and charges nil.

Costa Rica Electric Light and Traction Co., Ltd.—Capital, £130,000 in £1 shares. Return dated April 18th, 1928. All shares taken up. £7 paid. £129,993 considered as paid. Mortgages and charges, £278,550.

Power Contracts, Ltd.—Capital, £10,000 in £1 shares. Return dated May 11th, 1928. All shares taken up. £7,480 paid. £2,520 considered as paid. Mortgages and charges nil.

Lilleker Brothers, Ltd.—Capital, £3,000 in £1 shares. Return dated March 24th, 1928. 1,525 shares taken up. £225 paid. £1,300 considered as paid. Mortgages and charges nil.

Colne Valley Electric Supply Co., Ltd.—Satisfaction to the extent of £2,237 on May 31st, 1928, of debenture stock, dated July 4th, 1925, and November 20th, 1926, securing £100,000.

Astral Supply Co., Ltd.—Capital, £500 in £1 shares. Return dated December 31st, 1927 (filed March 5th, 1928). All shares taken up. £500 paid. Mortgages and charges nil.

City Notes.

United River Plate Telephone Co., Ltd.

The annual meeting was held on June 12th, Mr. P. Cross (chairman) presiding. In presenting the report and accounts (ELEC. REV., June 8th, p. 1011) the chairman said that the results were again satisfactory. In December last the ordinary capital was increased to £6,080,000 by the issue of 152,000 £5 shares. There was a net increase of 20,000 in the number of stations during the year, bringing the total up to 177,882, of which 110,616 were in the Federal Capital of Buenos Aires. The automatic system was proving successful and was giving great satisfaction to the public. They had already arranged for the conversion of 60 per cent. of the system to automatic working, and they had now ordered plant for a further 30,000 lines, which would increase the automatic system to about 80 per cent. of the whole. The company had undertaken not to dismiss any of the girl operators upon the conversion taking effect. It was expected that the new head office building would be completed by the end of this year, and they had already commenced to install one of the three new exchanges which would be housed in the building. There had been delay in securing permission to lay an underground trunk cable between Buenos Aires and Rosario, but as a result of a recent visit which he (the chairman) had paid to Argentina, it was hoped that the necessary sanction would soon be secured. The number of exchanges operated by the company was now 411, as compared with 362 at the end of 1926. Most of these were connected to Buenos Aires, the long lines being equipped with repeaters which gave very satisfactory results. The company's commitments would entail a further increase in capital, and they were accordingly asking the shareholders to raise the nominal capital to £8,000,000 by the creation of 200,000 new £5 shares. The money was not required at once, but when it was the shareholders would be given ample notice. After giving some statistics of the company's system, the chairman drew attention to the fact that the company's articles were out of date and new articles had been prepared for adoption. The report and accounts were approved and, later, resolutions providing for the raising of the capital and

the adoption of new articles of association were passed. In concluding the proceedings, the chairman referred to the rumours which had been spread regarding the possible acquisition of the company by American or other interests. He said that no proposal of the sort had reached the company. It was true, however, that the International Telephone and Telegraph Co. had acquired a small local concern in Buenos Aires, but he had been assured that that was only to provide the company with a terminal in Argentina for its system of long-distance international lines and was in no sense intended as competition with the United River Plate Company. The board was watching Transatlantic radio-telephony development and saw no reason why the company should not participate in its advantages. They were contemplating negotiations with the British Post Office and had grounds for stating that their advances would not be unwelcome.

Electric Construction Co., Ltd.

The annual meeting was held on June 12th, Mr. P. E. Beachcroft presiding. In proposing the adoption of the report (ELEC. REV., June 8th, p. 1011), the chairman said that when he addressed them last year he concluded by saying that the outlook was somewhat obscure, and the indications of a general improvement in trade were still unconvincing. That proved to be a fairly accurate forecast, as for the first half of the past financial year they experienced considerable difficulty in keeping their workshops reasonably employed. During the latter half of the year the demand improved, and they had commenced the new year with considerably more work in progress and with a larger number of unexecuted orders than a year ago. Competition was still very severe, and the profit on the manufacture of electrical machinery was quite incommensurate with the risks involved and the capital employed. They had had to adjust their prices from time to time to meet competition, but they had refrained from taking work at any price, and an accurate system of prime costing enabled them to judge how the interests of their business might be best conserved. He was sanguine, however, that the present state of affairs was only temporary, and with a real improvement in the basic industries of the country, and with the Electricity Act of 1926 in fuller operation, more prosperous times would be enjoyed by that branch of the electrical industry with which they were connected. The demand for power was increasing, and was likely to increase at such a rate as to render it difficult for electricity suppliers to cope with the demand with the plant at their disposal. Whether adequate supplies of electricity could be provided in rural areas at the low rates which had been suggested it was not his business to inquire, but there could be no doubt that a greatly increased demand for motors and electrical appliances would ultimately arise, and if only prices were quoted with due regard to the cost of production and the maintenance of the makers' reputation for quality, the success of companies like their own was assured. He thought that they had some indication of steady, progressive development of their particular department of trade. So long, however, as the basic industries remained in their present moribund condition, they must devote themselves to continued efforts to increase their output. If they could double their output—and they were in a very strong position and able to do so because they were fully equipped at Wolverhampton to meet any larger demand for their goods, which he confidently believed they would have in the near future—he hoped they might be in a position to present a still more satisfactory profit and loss account next year. Mr. James Gray, the managing director, seconded the motion, which was carried unanimously.

Lisbon Electric Tramways, Ltd.

In the course of his speech at the annual meeting on June 13th, Mr. L. Breitmeyer (the chairman) said that the traffics had been well maintained, and but for the interruption of the services during February last year the showing would have been much better. Both the number of passengers carried and the receipts had increased, but the slightly falling tendency in the exchange made the terms of remittances rather less favourable. The expenditure was considerably higher on account of heavier track renewals and expenses in connection with the recent capital issue. The plant, rolling stock, and permanent-way were being most efficiently maintained. The chairman then reviewed the accounts (*vide* our last issue, p. 1050), and referred to the recent issue of 317,013 ordinary shares as a 50 per cent. bonus to shareholders. He said that the opportunity had been taken of redeeming the outstanding debentures of the Cia. Carris de Ferro de Lisboa, and the company's own debentures now constituted a first charge upon the assets. The traffic returns for the current year showed a satisfactory increase, but unfortunately the exchange had not been so favourable of late. He hoped that the Portuguese Government would soon take steps to stabilise and strengthen the escudo which was so necessary for the welfare and prosperity of the country.

India Rubber, Gutta Percha and Telegraph Works Co., Ltd.

In a letter to the shareholders reviewing the company's trading for the first half of the current year the directors state that conditions still remain very difficult. In nearly all sections of the business the actual turnover was less than in the corresponding period of last year, but, notwithstanding this, the loss on trading has been very materially reduced, due to a large extent to economies effected in many directions. The position at the company's French works has continued to occupy the serious attention of the board, and very drastic alterations, both in *personnel* and in methods, have been made. There is every hope that the company will, before long, reap the benefit of those improvements. The submarine cable section, which was formerly a very important branch of the company's business, has of late become a very diminished source of profit, and there seems at present little hope of any great improvement. The board is endeavouring in every way to increase and extend the company's interests in other directions. It is regretted that the immediate outlook does not warrant the payment of any dividend to the ordinary shareholders, but the usual preference dividend is to be paid. It is announced that Sir John Ferguson, K.B.E., and Mr. F. W. Lloyd have accepted an invitation to join the board. Sir John Ferguson has also consented to take the position of chairman, and it is felt that his wide financial and commercial experience, coupled with the general engineering knowledge of Mr. Lloyd, will prove of great value to the company.

Stock Exchange Notices.

The undermentioned securities have been ordered to be officially quoted:—

Rangoon Electric Tramway and Supply Co., Ltd.—250,000 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 250,000.

Underground Electric Railways Co. of London, Ltd.—130,891 ordinary shares of £1 each, fully paid, Nos. 5,352,148 to 5,483,038.

Dealings in the following have been specially allowed by the Stock Exchange Committee under Rule 159:—

Greenwich Cable Works.—35,000 first cumulative 7 per cent. preference shares of £1 each, fully paid, Nos. B1 to B35,000; 25,000 second cumulative 7 per cent. preference shares of £1 each, fully paid, Nos. C1 to C25,000; 14,100 third non-cumulative 6 per cent. preference shares of £1 each, fully paid, Nos. D1 to D14,100; 34,561 ordinary shares of £1 each, fully paid, Nos. A1 to A34,561; £65,000 7 per cent. first mortgage debenture stock, partly paid and fully paid.

Johnson (Richard) & Nephew.—300,000 ordinary shares of £1 each, partly paid and fully paid, Nos. 300,001 to 600,000; 300,000 7 per cent. cumulative preference shares of £1 each, partly paid and fully paid, Nos. 1 to 300 000.

Quebec Power Company.—400,000 common shares of no par value; 100,000 new common shares of no par value, issued at $50 per share, partly paid and fully paid and fractions.

Sphere Investment Trust, Ltd.

The directors' report for the year ended March 31st last states that the dividends, interest, &c., received, less income tax, amounted to £46,160. During the year certain charges were made with a view to broadening the area of investment; the full benefit of the re-investment of funds has not yet accrued, and the amount of revenue has thus been restricted. After meeting expenses there is a credit balance of £42,874, to which is added £1,872 brought forward, making £44,745. Interim preference and ordinary dividends have been distributed, and it is now recommended that the balance of the preference dividend shall be paid and a final ordinary dividend at the rate of 4 per cent. (making 4 per cent. for the year). Meeting: To-day (Friday).

Madras Electric Supply Corporation, Ltd.

The accounts for the year ended December 31st last show a net profit of £63,667, as compared with £58,061 in the preceding year. A balance of £5,907 brought forward is added, making £69,574. After transferring £10,000 to reserve (against £5,124) a final dividend of 5¼ per cent., free of tax, is to be paid on the ordinary shares, making 8 per cent., free of tax, for the year, as for 1926; a balance of £6,657 is carried forward. Mr. J. G. B. Stone has succeeded Mr. J. Gray as chairman. The tramway accounts showed an available balance of £3,191, against £13,166. The 6 per cent. preference dividend is paid and the balance (£2,191) is carried forward. The meeting was to be held on Wednesday last.

Colombo Electric Tramways and Lighting Co., Ltd.

The net profit in Ceylon for the year ended December 31st, 1927, was £115,167, and the total available profit, including the balance brought forward, is £172,858, against £175,696 in the preceding year. The general reserve and renewal fund receives £71,694 (against £69,900). A dividend of 10 per cent. and a bonus of 10 per cent., both free of tax, are recommended, as in the previous year, leaving a balance of £74,995 to be carried forward, subject to income tax. The lighting department has now been handed over to the Ceylon Government, and the purchase money has been received.

Globe Telegraph and Trust Co., Ltd.

The report for the year ended May 31st records a net profit of £343,288, to which is added £51,375 brought forward, making £394,663. A final dividend of 5s. per ordinary share is to be paid on June 30th, making the usual total of 10 per cent., free of tax, for the year. The general reserve receives £20,000, leaving a balance of £52,322 to be carried forward. The report contains a list of investments, the principal being the Eastern Telegraph Co., Ltd., ordinary (nominal value £1,258,915), Eastern Extension, &c. (£973,200), and the Western Telegraph Co., Ltd. (£679,000).

Kalgoorlie Electric Power and Lighting Corporation, Ltd.

The profit for the year ended December 31st, 1927, was £26,842, as compared with £25,899 in 1926. A balance of £978 brought forward is added, making £27,820. From this £10,000 is set aside for depreciation and £4,890 for income tax. The directors recommend a dividend of 6 per cent. (the same) on the ordinary shares, leaving £781 to be carried forward. The meeting was to be held yesterday (Thursday).

Folkestone Electricity Supply Co., Ltd.

An extraordinary general meeting is called for June 25th, to consider resolutions providing for the raising of the capital to £237,500 by the creation of 37,500 additional shares of £1 each, of which 35,000 will be ordinary shares ranking *pari passu* with the existing ordinary shares and 2,500 will be employés' co-partnership shares ranking with the existing co-partnership shares; and increasing the directors' remuneration from £800 to £1,200 per annum.

Scottish Power Co., Ltd.

On Tuesday last this company offered for public subscription 600,000 £1 ordinary shares at 26s. each. The company has an authorised capital of £2,500,000, of which £1,700,000 has been issued (including the present offer). The net earnings in the past four years have been as follows:—1924, £51,596; 1925, £58,044; 1926, £62,281; and 1927, £99,450. In each of the four years a dividend of 8 per cent. has been paid on the ordinary shares. The company owns the capital of seven Scottish companies operating in a wide area, and the system includes the Grampian hydro-electric development, to which part of the proceeds of the present issue is to be devoted. The other objects of the issue are to provide funds for the extension of plant and mains and for the redemption of the outstanding debenture stock (£43,500).

Whitehall Electric Investments, Ltd.

The accounts for the year ended March 31st last show that the gross income rose from £712,482 to £721,951, and the net income from £468,656 to £504,267. The ordinary dividend is increased from 2¼ per cent. to 4 per cent. £36,766 is written off debenture stock discount and £80,000 is carried forward. The meeting was to be held yesterday (Thursday).

Falk, Stadelmann & Co., Ltd.

On Wednesday last the Industrial Finance & Investment Corporation, Ltd., offered for subscription, on behalf of this company, 450,000 7 per cent. cumulative preference shares of £1 each at par and 112,500 ordinary shares of £1 each at 22s. per share. The authorised capital is £1,100,000, and of this £1,000,000 has been issued or agreed to be issued. 100,000 preference shares are to be taken up by the directors and their friends. The company's assets are stated to have a net value of £1,281,717, and the average profit for the past four years has been £90,522. The lists were closed on the morning of the day of issue.

Ransomes, Sims & Jefferies, Ltd.

The net profit for the past year rose from £18,887 to £19,835, and the directors propose to pay an ordinary dividend of 2½ per cent. (against *nil* for the preceding year). No contribution is made to reserve; £10,000 was allocated for this purpose in the previous year.

James Keith & Blackman Co., Ltd.

The available balance for the year ended March 31st last, after providing for debenture interest and preference dividend, is £43,065. It is proposed to place £10,000 to reserve, to pay a dividend of 12½ per cent. on the ordinary shares, and to carry forward £13,065.

Callender's Cable and Construction Co., Ltd.

A final dividend of 10 per cent. has been declared on the ordinary shares, making 15 per cent. for the year as for 1926-27.

The report for the past year shows that the profit rose from £356,590 to £357,378. It is proposed to increase the capital of the company to £2,300,000 by the creation of 500,000 ordinary shares of £1 each. These will be issued at such times and on such terms and conditions (including payment of a premium) as the directors shall think fit. Meeting: June 28th.

Northampton Electric Light and Power Co., Ltd.

The company has notified shareholders of the necessity for surrendering their certificates of ordinary and preference "B" shares on account of the re-numbering and re-classification of those shares.

Richard Johnson & Nephew, Ltd.

The issue of 300,000 7 per cent. cumulative preference shares of £1 each made on June 12th was largely over-subscribed on the day of issue, but country applications received by the first post of the following day were to be considered.

Italian Loan in New York.

Last week an issue of $4,000,000 of one-year 5½ per cent. first mortgage gold notes was made in New York on behalf of the Piedmont Hydro-Electric Co., Italy.

Anglo-Argentine Tramways Co., Ltd.

The directors have declared dividends on the 5½ per cent cumulative first preference shares and the 6 per cent. cumulative second preference shares for the half-year ending June 30th.

Mirrlees, Bickerton & Day, Ltd.

The directors again recommend a dividend of 6 per cent. on the ordinary shares in respect of the year ended March 31st.

Hall Telephone Accessories (1928), Ltd.

An interim dividend of 4 per cent. has been declared.

French Companies.

The *Compagnie Radio-France* has approved the payment of a dividend at the rate of 35 fr. per share out of net profits amounting to 4,513,000 fr. in 1927.

The *Union d'Electricité* reports net profits of 23,703,000 fr. for 1927, as compared with 20,030,000 fr. in the preceding year. It is proposed to pay a dividend of 10 per cent., against 9 per cent.

Stocks and Shares.

MONDAY EVENING.

STOCK Exchange markets have fallen a good deal under the influence of financial disturbances in America, caused by the wave of gambling which rose to its crest about a month ago. The New York bankers evidently became apprehensive of the lengths to which inflation of values was proceeding, and, by their action in raising money rates, the bankers placed such a check upon bullish enthusiasm as led to a general reduction in the bull account, with the wholesale cutting down of prices amongst the more speculative varieties. Thus, International Holdings, a company which is concerned with artificial silk and other industrials, fell from 330 to 230 within a week or so. Hydro-Electrics, which is another of the gambling stocks with a large following in Brussels, as well as New York and London, dropped from 85 to 55. Spectacular movements of this nature react upon international markets, and serve to unsettle the minds of speculators in other stocks and shares. The result is seen in the cessation of the industrial boom that characterised the London Stock Exchange market during the first three months of the year. The public are now exercising a good deal of discrimination in the selection of their investments. There is still plenty of money available, and good stock is readily taken. The premium on the new Underground Electric Railways of London debenture is maintained at 2¼, while on the recently issued Tokio Electric 6 per cent. first mortgage bonds a premium of 3¼ is firmly held.

"Dollar" Stocks.

Brazilian Tractions have been moving in wide curves. The shares may be included amongst those which are affected by New York; the price dipped to 53 at one time lately, from which it has recovered to 56½. Mexico Tramways, after being down to 32, ran up to 37. Bonds and prior-charge issues in this section have been little affected. Mexican Light and Power common shares continue flat at 75. Hydro Electrics rose to 64, and reacted to 60. Canadian General Electrics are better at 107½. In the sterling stocks, Perak River ordinary shares strengthened to 19s., and the 7 per cent. participating debenture has advanced to 113½.

Home Rails and Trams.

The Home Railway market would be in a parlous condition if it were not for the mild activity shown by the electric stocks. Underground Electric income bonds have fallen 2 points, and the shares are unchanged at 26s. 6d. Metropolitans and Districts are dull. Nothing fresh has transpired in connection with the anticipated plan for co-ordinating into one whole the various systems of London traffic, nor is it thought likely that anything definite will be announced for some months to come. The hopeful folks who bought London and Suburban and London United Tramways issues not long ago, under the impression that some scheme for the unification of London traffic was on the point of being published, are regretting their haste, and small sales of the shares account for the present dullness of the prices. London and Suburban Traction preference being 9s. 6d., London United Tramways preference 6s.; London and Suburban 5 per cent. "A" debenture stock is, however, 2 points better at 72½.

Stocks on Offer.

Anglo-Argentine Tramways remain good, for the reasons mentioned here last week; namely, that attention has been directed to them, both first and second preference, by reason of the high yields obtainable by the investor. The company has declared the usual dividends, which are payable on July 2nd. There is not a great deal of debenture stock on offer in this market. Southern Brazil Electric 6½ mortgage debentures to bearer can be bought at 78½, to pay 8½ per cent. on the money, with January and July interest payments. Sao Paulo Electric 5 per cent. 50-year first mortgage bonds, obtainable at 94, yield £5 6s. 3d. per cent., the principal, interest and sinking fund being guaranteed by the Brazilian Traction Company. London Power 5 per cent. new debenture has risen

to 101¼; Electric Finance and Securities 5½ per cent. debenture is offered at 99½, free of stamp and fee. Greenwich Cable Works 7 per cent. first mortgage debenture can be obtained at 100, also free of stamp, a part interest payment being due on January 1st, 1929. The stock is convertible, up to June, 1933, into £1 ordinary shares at par. County of London Electric 5 per cent. debenture has risen to a shade over 100, and Lancashire Electric Light and Power 5 per cent. debenture at 100 is ex dividend. Urban 5½ per cent. debenture is harder at 100. West Gloucestershire 6½ per cent. preference has dropped to 80.

Electric Preference Shares.

The Whitehall Electric Investments has done very well, and the report just out shows a progressive increase in profits. The price of the preference shares has strengthened a trifle; it still allows a yield of 6¼ on the shares at 24s. Scottish Power 6 per cent. preference have risen to 22s. 9d., the yield in their case being about £5 5s. per cent., and Power Securities 7 per cent. cumulative participating preference at 27s. return £5 3s. 6d. per cent. on the money, the attraction here being that the shares rank for an extra ½ per cent. for every 1 per cent. paid over 8 per cent. on the ordinary. The aggregate preference dividend in any one year may not exceed 10 per cent. There are a few Edmundson's preference available at 26s. or a little less. Edison Swan 7½ first preference can be bought at 25s. 6d., while the preference shares of the Charing Cross and of the County of London Companies yield a bare 5 per cent. on the money at ruling quotations.

Provincial Shares.

Midland Counties Electric ordinary shares have risen to 30s. 6d., on a renewal of the buying which recently was so considerably in evidence. The company last paid 6½ for the year, and on this basis the shares yield very little over 4 per cent. on the money. It is, however, expected that by steady degrees the dividends will be advanced to 8 per cent., and it is on this assumption that people are buying the shares. Newcastle-on-Tyne Electric ordinary at 27s. 6d. pay 4½ per cent., and Richmond Electric ordinary at 2½ yield 4¼ per cent. on the basis of the last year's 10 per cent. dividend. It is difficult to estimate the precise yield on Bournemouth & Poole ordinary, owing to the share bonus recently distributed, but Egham & Staines at 40s. return 3¾ per cent. on the 7½ per cent. dividend paid in 1927. The Scottish Power Company is making an issue this week of 600,000 ordinary shares of £1 each at 26s. As the existing shares stand in the market at 30s., there can be no doubt as to the reception which the new issue will obtain. Some amusement was caused in the market by the report of a speech by a West Ham engineer, at the annual conference of the Incorporated Municipal Electrical Association, in which he denounced the land grabbing policy of supply companies, backed in some instances by American capital.

The Kalgoorlie Electric Power and Lighting Company has repeated its previously paid dividend of 6 per cent. less tax, and the accounts show a slight increase in the profit for 1927 over those of 1926.

The Manufacturing Group.

India Rubber shares have risen 2s., to 15s. 9d. The report, just out, says that the loss on trading has been materially reduced: the ordinary are to go without a dividend, but the usual preference dividend will be paid early next month. The directors state that conditions still remain very difficult. It would appear, from the demand for the shares, as though the disclosure of a better state of affairs is expected a year hence. Callenders dropped to 83s. 9d., the dividend being unchanged at 15 per cent. for the year. Henley's announcement is due on Friday in this week. Enfield ordinary at 86s. 3d. are easier on balance. English Electrics are weak at 7s. Johnson and Phillips fell to 4¼. Small rises occurred in British Aluminium ordinary, Crompton-Parkinson preferred ordinary, and the 8 per cent. preference. The general tendency of manufacturing shares is steady, business in this section being of somewhat retail character. The engineering and iron and steel departments are also uninteresting, the outstanding feature being the strength shown by the shares in the really good companies, while those of more speculative character are neglected.

Cable and Wireless.

After being distinctly weak, the market for cable and telegraph stocks has taken a turn for the better, with the result that the changes are unimportant. Eastern ordinary fell to 210 before recovering to 220, and the shares of the Eastern quartette behaved in similar fashion. Globe Telegraph and Trust declared its usual quarterly dividend of 5 per cent. net, making 10 per cent. for the year, the same as before; and it is taken for granted that the others will continue their 10 per cent. free of tax distribution. United River Plate are ex dividend and show ¼ rise, allowing for the deduction. Marconis have been revolving round about 64s. 6d., the market in their case being affected by, as much as anything else, the tendency of the Stock Exchange as a whole. Wireless communication has been established between America and Australia. Canadian Marconis have eased off a trifle, and Radio Corporation shares have been fluctuating in accordance with the breaks and bulges of the excited New York Stock Exchange market. International Automatic Telephones at 39s. 6d. are better on the week.

Share List of Electrical Companies.

	Nom. £	Dividend. 1926.	Dividend. 1927.	Price June 18, 1928.	Rise or fall.	Yield. p.c.
Home Electricity Companies.						
Bournemouth and Poole	1	14†	15⅝	21/3	—	... ...
Brompton Ordinary	1	8⅝	8½	25/6	—	5 9 10
Charing Cross Ordinary	1	8½	8½	27/-	—	5 3 8
do. do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8¾	8¾	28/6	—	5 5 8
City of London	1	10	10	87/9	—	4 11 1
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	29/-	—	4 2 1
County of London	1	7½	7½	38/6	−6d.	3 18 0
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundsons' 7% Pref.	1	7	7	27/3	—	5 9 10
Elec. Supply Corporation	1	11	11	55/-	−½	4 0 0
Kensington Ordinary	1	8	8	27/6	—	5 5 8
Lancs. Light and Power	1	7½	7½	29/-	—	5 3 5
London Electric	1	8½	8½	26/6	—	5 5 10
do. do. 6% Pref.	5	6	6	5½	—	5 8 2
Metropolitan	1	8	9	2 5/8	−1/8	3 18 0
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6½	30/6	+6d.	4 5 3
Mid. Elec. Power	1	—	15	38/9	—	... ...
Newcastle-on-Tyne Ordinary	1	5	6	27/6	—	4 6 8
do. 7% Pref.	1	7	7	26/6	—	5 5 8
Notting Hill 6% Pref.	10	6	6	10⅝	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	2 5/-	—	5 4 4
St. James' and Pall Mall	5	8	8	27/-	—	5 3 8
Scottish Power	1	8	8	30/-	—	5 6 8
South London	1	8½	8½	26/6	—	5 5 8
Urban Ordinary	1	7	7	31/3xb	—	... ...
Westminster Ordinary	1	8½	8½	37/-	—	5 3 8
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	23/9	+1½d.	6 6 4
Yorkshire Elec.	1	8	8	33/6	—	4 15 7
Home Rails.						
Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	3	3	70	−1	4 5 9
do. District	,,	3½	4	75	−½	5 6 8
Underground Electric	£1	1½	5	26/3	—	3 15 6
do. do. Income	Bonds	6	6	125	−2	4 16 0
Telegraphs and Telephones.						
Anglo-Am. Tel. Pref.	Stock	6	6	100½	—	5 19 5
do Def.	,,	1½	1½	24¼	—	6 3 9
Automatic Telephone	1	10	10	45/-	—	4 9 0
Eastern Extension	10	10	10	22	—	*4 11 0
Eastern Tel. Ord.	Stock	10	10	220	—	*4 11 0
Globe Tel. and T. Ord.	10	10	10	22	—	*4 11 0
do. do. Pref.	10	6	6	11	—	5 9 1
Great Northern Tel.	10	20	20	39	—	5 2 7
Indo-European	25	10	10	42½	—	*5 17 8
Marconi	10/-	5	—	65/-	—	0 15 4
Marconi-Marine	1	8¾	12½	4 9/-	−9d.	5 4 2
Oriental Telephone Ord.	1	12	12	53/6	—	*4 9 3
United R. Plate Tel.	5	8	8	11½xd.	+¼	*8 12 0
Western Telegraph	10	10	10	21⅞	—	4 12 0
Home and Foreign Trams, &c.						
Anglo-Arg. Trams First Pref.	5	5½	5½	8½	—	7 0 8
do. do. 2nd Pref.	5	6	6	8⅞	—	7 14 10
do. do. 5% Deb.	Stock	5	5	76½	—	6 11 2
British Electric Traction Def. Ord.	,,	—	—	530	—	... ...
do. do. Pref. Ord.	,,	8	7½	125½	+1	5 19 6
Brazil Traction	100	6	7	56½	+2	3 2 0
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	96½	+1	5 3 8
do. do. Preferred	,,	6¼	6¼	268	—	*2 6 9
do. do. Deferred	,,	8	8	307	—	*2 12 1
London & Sub. Trac. 5% Pref.	1	Nil	Nil	9/6	—	... ...
London United Tram Deb.	Stock	4	4	61½	−1	6 10 0
Mexico Trams, 5% Bonds	—	5	5	86½	−1	5 15 7
Mexican Light Common	100	Nil	Nil	75	−2	... ...
do. 7% Pref.	100	Nil	7	79	—	8 17 2
do. 1st Bonds	—	5	5	82½	—	6 1 3
Yorkshire (West Riding)	1	Nil	Nil	7/6	—	... ...
Manufacturing Companies.						
Babcock & Wilcox	1	12	15	67/6	—	*4 9 0
British Aluminium Ord.	1	10	10	47/6	+6d.	*4 4 2
British Elec. Transformer Pref.	1	7	7	18/-	—	7 15 7
British Insulated Ord.	1	15	15	4	—	3 14 0
Brush Ord.	1	10	10	22/9	—	6 19 0
Callenders	1	15	15	4 7/8	−1/8	3 12 0
do. 6½% Pref.	1	6½	6½	23/-	—	5 9 6
Crompton Parkinson Pref. Ord.	1	—	—	18/-	+6d.	... ...
do. 8% Pref.	1	—	8	26/3	+1/8	6 2 0
Edison-Swan	4/-	10	10	12.6	—	3 4 4
do. 5% Deb.	Stock	5	5	90	—	5 11 0
Electric Construction	1	7½	—	27/6	—	5 9 1
Enfield Cable Pref.	1	7½	7½	26/3	—	5 14 3
English Electric	1	Nil	Nil	7/-	−1/9	... ...
do. do. Pref.	1	3	Nil	11/3	—	... ...
Gen. Elec. Pref.	1	6¼	6¼	25/ xd.	—	5 4 4
do. Ord.	1	7½	—	38/-	—	3 19 0
Henley	1	25	—	5⅞	—	4 3 4
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	Nil	Nil	15/9	+2/-	... ...
Johnson & Phillips	1	12½	10	42 6	−1/8	4 14 1
Met.-Vickers Ord.	1	8	6	1 5/8	—	3 16 10
do. Pref.	2	8	8	2	—	6 1 11
Siemens Ord.	1	7½	7½	28/3	—	5 4 4
Telegraph Construction	12	10	10	26½	—	*4 10 11

* Dividends paid free of Income Tax.
† 4% of which was Tax Free.

Our Foreign Electrical Trade.

Electrical Exports and Imports during May, 1928.

THE returns of our foreign electrical trade during May, show an improvement in exports. The total of £1,599,250 was above the monthly average for the years 1926 and 1927, and as compared with April showed a rise of about £170,000. This increase was general, there being only three very small decreases. The machinery section recorded the greatest improvement; the net gain shown by the three classes was £105,310. Telegraph and telephone apparatus also recovered from its previous month's fall, rising by £41,404. Only two other increases were of importance, namely, those in glow lamps, and batteries and accumulators.

The comparison with the corresponding month of last year shows a smaller rise, while so far as the individual items are concerned increases and decreases are equal in number. The outstanding feature is a rise of £86,474 in telegraph and telephone apparatus. The large increases in unenumerated goods and "other" motors and generators, are more than offset by the falls in insulated wires and cables, unenumerated electrical machinery, and submarine cables. The increase in the export total for May brings this year's exports above the total for the corresponding period of last year for the first time.

So far as imports are concerned, little change occurred during May. The rise above the April figure was only £14,000, the principal contributions being made by batteries and accumulators and telegraph and telephone instruments and apparatus. The greatest decline occurred in non-submarine telegraph and telephone wires and cable. The increase shown in comparing the figures with those for May, 1927, was only £2,673, but the fluctuations in some of the items were wide. For instance, there was an increase of £23,450 in imports of telegraph and telephone apparatus, while imports of unenumerated machinery fell by £19,807, and those of meters and instruments by £10,307. The total for the completed portion of the year is still well above the corresponding figure for 1927.

Although re-exports were lower last month than in April they were well above the May, 1927, level.

The following table analyses our electrical machinery exports during May according to their destinations and compares the amounts with those for May, 1927:—

Destination.	May, 1927.	May, 1928.	Inc. or dec.
	£	£	£
Europe	104,870	94,037	−10,833
Japan	21,781	28,962	+ 7,181
South America ...	69,806	82,665	+12,859
South Africa ...	99,884	42,826	−57,058
British India ...	89,567	113,754	+24,187
Australia	101,295	112,906	+11,611
New Zealand ...	30,655	18,083	−12,572
Canada	34,112	32,685	− 1,427
Other countries ...	55,572	80,651	+25,079
Totals	£607,542	£606,569	− £973

	Exports.			Imports.			Re-Exports.		
	Electrical exports for May, 1928.	Inc. or dec. as compared with April, 1928.	Inc. or dec. as compared with May, 1927.	Electrical imports for May, 1928.	Inc. or dec. as compared with April, 1928.	Inc. or dec. as compared with May, 1927.	Electrical re-exports for May, 1928.	Inc. or dec. as compared with April, 1928.	Inc. or dec. as compared with May, 1927.
Electrical goods and apparatus (unenumerated)	£209,759	+ £1,643	+ £23,326	£100,788	− £219	− £4,209	£7,488	+ £1,211	+ £3,264
Insulated wires and cables ...	230,195	+ 150	− 27,718	54,499	+ 3,635	− 4,367	1,113	+ 796	+ 779
Glow lamps	51,322	+ 10,111	− 2,889	27,138	+ 3,386	+ 5,700	149	− 1,046	− 1,336
Arc lamps and parts	2,311	+ 640	+ 1,679	4,118	+ 9	+ 401	—	− 16	− 51
Batteries and accumulators ...	92,640	+ 10,860	− 7,188	47,440	+ 9,881	+ 4,847	972	+ 410	+ 254
Meters and instruments ...	38,851	+ 5,391	+ 8,568	18,939	− 1,434	− 10,307	320	− 978	+ 67
Carbons	908	+ 189	− 1,044	14,404	+ 537	+ 3,251	155	+ 93	+ 150
Switchboards (not telegraph or telephone)	4,445	+ 745	+ 1,543	28	− 4	− 378	23	+ 6	+ 25
Electrical Machinery—									
Electrical machinery (unenumerated)	332,036	+ 60,259	− 23,025	147,128	− 1,197	− 19,807	12,821	− 1,555	+ 3,797
Railway and tramway motors	64,376	+ 48,355	+ 1,073	—	—	—	—	—	—
Other motors and generators...	210,157	− 3,304	+ 20,979	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	72,104	− 4,688	− 12,138	3,016	− 6,475	− 4,026	67	− 22	− 112
Submarine telegraph and telephone cable...	10,301	− 1,999	− 23,121	—	—	—	—	—	—
Telegraph and telephone instruments and apparatus ...	279,945	+ 41,404	+ 86,474	50,515	+ 5,882	+ 23,450	2,104	− 519	+ 587
Totals	£1,599,250	+ £169,739	+ £46,519	£468,013	+ £14,001	+ £2,673	£25,214	− £1,620	+ £7,424
		Exports.			Imports.			Re-Exports.	
Increases for 1928		+ £45,726			+ £289,603			+ £17,430	

Australian Tariff Applications.

The Commonwealth Tariff Board continues to hear applications from manufacturers of all classes of goods for increased duties upon imported products. The question whether turbo-alternators, transformers, motors, and other electrical plant and machinery were being manufactured commercially in Australia was recently investigated. Giving evidence, Mr. F. W. Wheadon (Adelaide Electric Supply Co., Ltd.) made reference to a quotation for a 10 000-kW alternator by Thompson & Co., Castlemain (Vic.). The price was £47,600, exclusive of the condenser, with extras amounting to £2,900, and it was stated that half of it would be made in Australia. Mr. Wheadon said that if the tender was placed on the same basis as the English tenders, the plant would cost £15,079, or 63 per cent., more than the overseas quotations. He showed that the cost, including duties, would be 32.5 per cent. more than that of the complete imported article; without duties it would cost 63 per cent. more. Therefore, he maintained, the manufacture of turbo-alternators in Australia was at present premature and uneconomical.

Portuguese Import Duties.

Under a recent decree of the Portuguese Government, imported "boards or panels for the control, distribution, observation and measurement of electrical energy, including the necessary fittings therefor," are to be subject to duties of 10 per cent. under the "minimum" tariff, and 20 per cent. under the "maximum" tariff.

The Electrical Trade of Hungary.

Statistics for 1926 and 1927 Compared.

THE following table gives particulars of Hungary's imports and exports of electrical machinery last year, the total values in 1,000 gold crowns being stated, together with the total weights in quintals, and the weights by countries of origin or destination. Comparative figures for 1926 are added, and notes of any increases or decreases also given :—

Imports.

	1926.	1927.	Inc. or dec.
Dynamos, motors and transformers—			
Value in 1,000 gold crowns ...	2,860	4,112	+1,252
Quintals	4,545	7,268	+2,723
Austria	1,393	3,181	+1,788
Czecho-Slovakia	560	37	− 523
Germany	1,340	2,177	+ 837
Italy	83	478	+ 395
Switzerland	197	625	+ 428
Heating and cooking apparatus—			
Value in 1,000 gold crowns ...	75	177	+ 102
Quintals	129	163	+ 34
Austria	37	47	+ 10
Germany	87	112	+ 25
Electric meters—			
Value in 1,000 gold crowns ...	410	383	− 27
Quintals	306	248	− 58
Austria	33	37	+ 4
Germany	215	193	− 22
Belgium	54	13	− 41
Electric measuring and signalling apparatus—			
Value in 1,000 gold crowns ...	114	151	+ 37
Quintals	57	120	+ 63
Germany	48	62	+ 14
Austria	7	41	+ 34
Telegraph and telephone apparatus—			
Value in 1,000 gold crowns ...	1,860	2,797	+ 937
Quintals	872	882	+ 10
Austria	337	69	− 268
Germany	396	465	+ 69
Holland	29	82	+ 53
Conduit, tubing, &c.—			
Value in 1,000 gold crowns ...	78	101	+ 23
Quintals	389	655	+ 266
Czecho-Slovakia	75	54	− 21
Germany	140	479	+ 339
Austria	173	113	− 60
Starters, resistances, regulators, &c.—			
Value in 1,000 gold crowns ...	1,643	3,522	+1,879
Quintals	2,198	3,896	+1,698
Austria	783	875	+ 92
Germany	1,021	1,675	+ 654
Czecho-Slovakia	161	68	− 93
Arc lamps and electric projectors—*			
Value in 1,000 gold crowns ...	83	225	+ 142
Quintals	96	162	+ 66
Incandescent lamps—			
Value in 1,000 gold crowns ...	332	714	+ 382
Quintals	319	475	+ 156
Austria	56	179	+ 123
Germany	208	243	+ 35
Accumulators, batteries and parts—			
Value in 1,000 gold crowns ...	164	199	+ 35
Quintals	294	524	+ 230
Germany	120	125	+ 5
Sweden	70	83	+ 13

Exports.

Electric measuring and signalling apparatus—			
Value in 1,000 gold crowns ...	38	51	+ 13
Quintals	44	20	− 24
Germany	11	1	− 10
Austria	11	3	− 8
Rumania	6	7	+ 1
Dynamos, motors and transformers—			
Value in 1,000 gold crowns ...	4,257	3,640	− 617
Quintals	19,656	13,339	−6,317
Austria	1,798	1,829	+ 31
Czecho-Slovakia	278	200	− 78
Rumania	1,990	1,210	− 780
Germany	47	36	− 11
Italy	6,002	4,184	−1,818
Belgium	1,008	—	—
Poland	790	851	+ 61
Jugo-Slavia	1,684	1,183	− 501
Brazil	524	1,849	+1,325
Heating and cooking apparatus—			
Value in 1,000 gold crowns ...	5	—	—
Quintals	11	—	—
Austria	5	—	—
Germany	4	—	—
Electric meters—			
Value in 1,000 gold crowns ...	1,038	849	− 189
Quintals	1,585	1,125	− 460
Austria	6	23	+ 17
Rumania	178	210	+ 32
Jugo-Slavia	86	146	+ 60
Italy	812	230	− 582
Belgium	182	88	− 94
Poland	111	—	—
Railway signalling and safety apparatus—			
Value in 1,000 gold crowns ...	8	—	—
Quintals	69	—	—
Rumania	15	—	—
Telegraph and telephone apparatus—			
Value in 1,000 gold crowns ...	1,428	2,630	+1,202
Quintals	1,679	2,139	+ 460
Rumania	755	799	+ 44
Germany	13	111	+ 98
Jugo-Slavia	417	614	+ 197
Poland	68	80	+ 12
Conduit, tubing, &c.—			
Value in 1,000 gold crowns ...	51	15	− 36
Quintals	407	277	− 130
Rumania	394	209	− 185
Starters, resistances, regulators, &c.—			
Value in 1,000 gold crowns ...	930	538	− 392
Quintals	2,910	1,557	−1,353
Austria	394	485	+ 91
Jugo-Slavia	572	281	− 291
Rumania	383	268	− 115
Poland	234	95	− 139
Italy	521	114	− 407
Incandescent lamps—			
Value in 1,000 gold crowns ...	7,466	7,836	+ 370
Quintals	9,535	9,556	+ 21
Austria	725	324	− 401
Czecho-Slovakia	836	631	− 205
Rumania	794	758	− 36
Jugo-Slavia	690	789	+ 99
Germany	1,691	2,910	+1,219
Brazil	1,012	618	− 394
Argentina	855	352	− 503
Accumulators, batteries and parts—			
Value in 1,000 gold crowns ...	44	102	+ 58
Quintals	175	562	+ 387
Rumania	52	—	—
Jugo-Slavia	85	189	+ 104
Bulgaria	26	356	+ 330

* Mainly from Germany.

Hungarian Import Duties.

The *Board of Trade Journal* points out that the Hungarian decree of April 23rd did not revoke the provisions under which electric lighting and starting apparatus for automobile factories are subject to a reduced duty of 10 per cent. of the nominal rate. The reduced duty is now also applicable to such apparatus imported by aircraft factories.

The I.M.E.A. in the West Country.-III.

A Report of the Proceedings and Social Functions of the Annual Convention at Bath.

AS we foretold, the City of Bath won the approval of the visitors who attended the Convention last week; and as though its permanent attractions might not suffice to that end, the Electricity Department, under the supervision of the City electrical engineer, Mr. J. W. Spark (whose undertaking was referred to on p. 978 of our issue of June 8th), prepared and carried out a scheme of electric illumination which enhanced the beauties of the place and revealed new features of charm. The great square tower of the Abbey was bathed in a flood of light, and stood out above the shadowy bulk of the nave and transepts in solemn grandeur—a sight worth travelling far to see. The Institution Gardens, and the river, which tumbled over the weir in rushing radiance, were effectively illuminated with flood-light and fairy lamps; the Great Roman Bath was lighted with green rays, and in the hypocausts and hot-air chambers in the covered portion of the site red lamps were cunningly disposed, whilst the Roman Museum was brightly lighted on normal lines. Every evening during the Convention the Roman remains were thus on view, and aroused the keenest interest, to which the lectures given on several occasions by the consulting architect, Mr. A. J. Taylor, F.R.I.B.A., greatly contributed.

Elsewhere in the City the presence of an electrical Convention was strongly emphasised. The Exhibition organised under the auspices of the I.M.E.A., in the Assembly Rooms, was noteworthy for its size and for the novelty of many of the exhibits; some of the exhibitors also opened special showrooms in the City—notably Messrs. Berry's Electric, Ltd., the British Thomson-Houston Co., Ltd., Messrs. L. G. Hawkins & Co., Ltd. (at Messrs. Morrison Bros.' premises), Messrs. Philips Lamps, Ltd., and (at the Electricity Department's showrooms) the General Electric Co., Ltd.

It was interesting to be reminded by Sir Harry Hatt, when he welcomed the Association on behalf of the Mayor and Corporation, that Bath contained the oldest engineering works in the country, that of Messrs. Stothert and Pitt, Ltd. (see p. 978 of our issue of June 8th). The postal system of this country was started in Bath, by Ralph Allen, many years before the age of steam, and it was a Bath man who invented the kinematograph and showed the first moving pictures. The president of the Association, Mr. F. W. Purse, was a member of the Bath electricity staff in his early days. Sir Harry claimed that Bath, Taunton, and Exeter, were the three pioneers of electric lighting in this country, and the Bath station was the first in which electricity was generated at 2,000 volts. In Bath, too, was laid the first underground cable for the distribution of electricity, and as recently as 1925, Bath successfully promoted a Bill in which for the first time a clause giving the Corporation power to sell fittings and wire premises was carried through both Houses of Parliament.

Messrs. J. H. C. Brooking and J. R. Cowie.

Mr. and Mrs. H. C. Lamb.

Ald. and Mrs. W. A. Walker.

Well-known Engineers at the Convention.

The Start for Somerdale.

Assembling at the Theatre Royal.

Administration of Electricity Supply Undertakings.

Discussion on Paper by Messrs. Alex. Sinclair and J. W. Burr.

Councillor H. COATES (Watford) said he did not consider the suggestion to give an electricity committee the same powers as a board of directors was a practicable proposition. In the case of a company the board was almost invariably financially interested in the concern, but an electricity committee was not. Further, the Council must be the ultimate authority. As a rule the majority of a committee's recommendations were adopted, and, on the whole, he did not think the present system could be improved upon. There might be greater freedom given to electricity committees with regard to ordinary running expenses, but he could not agree that the committee should be given a freehand as regards capital expenditure.

Judge COUSTON (Edinburgh) remarked that, whilst he could not accept the proposal that the electricity committee should be independent of control of the council, it was necessary that the council should have the utmost confidence in the committee and the engineer, and that the engineer should be protected by the chairman of the committee taking full responsibility for any actions of the committee. In Edinburgh the committees were not elected on any principle influenced by party politics, but by a majority of the Council, and for that reason the Council had the fullest confidence in its committees. In certain matters the committees had powers under Standing Orders, such as regarded running expenses, and although, as a rule, the recommendations of the electricity committee were accepted, he could not agree that the Committee should deal, for instance, with the extensions now in hand amounting to £3,500,000, without the consent of the Council.

Councillor J. TAYLOR (Torquay) also disagreed with the suggestion that an electricity committee should have the same powers as a board of directors, for the reason that very often members of electricity committees were directors of the local gas company. As regarded financial control, in Torquay separate books were kept by the electricity undertaking, and he felt that a good deal of useless expense was involved. Money could be saved by co-ordinating the accounts. He was not at all sure that it would not be necessary to obtain the consent of the Electricity Commissioners to the appointment of members of electricity committees throughout the country in order to get suitable men.

Councillor R. S. CHATFIELD (Eastbourne), after urging local authorities to do everything possible for the staffs that might be displaced under the working of the Electricity Act, commented upon the technical nature of the work of electricity committees, and recommended that the members should be elected for a longer period than was now the case, so that they would be able to acquaint themselves thoroughly with the details of electricity supply management, and be of real service to the undertaking as a consequence.

Councillor R. MATTHEWS (Chester) said the suggestion that because of the present system municipal undertakings were not as efficiently managed as company undertakings was not borne out by the statistics. One of the factors for success in a municipal electricity undertaking was that there should be an engineer and business man combined, and he disagreed with the suggestion that it was impossible to find such a man.

Alderman H. B. VORLEY (Islington) emphasised the point that the first essential to success in municipal electricity supply was to have an engineer in whom was felt the greatest confidence. A great deal of trouble was caused by electing practically new committees every three years. Politics, as far as electricity was concerned, were a curse, and too often the policy of a council was changed merely because the new council determined to change what the previous council had done. He agreed that electricity committees should have greater powers than they now had, but not to the extent advocated in the paper; the council must be top-dog. He thought that electrical finance was part of electricity technique and should be under the control of the committee.

The PRESIDENT apologised for not calling upon engineers to take part in the discussion, but said that the paper was essentially one for councillor members, and he thought it best to let them fight it out amongst themselves.

Alderman Sir HARRY HATT (Bath) said there seemed to be a tendency to exaggerate the difficulties arising under the present system. Matters concerning large capital expenditure should be controlled by the council, but in minor matters the committee might be given greater powers.

Mr. BURR, in a short reply, regretted that the discussion had not ranged over a wider number of matters. Most attention had been devoted to the question of giving executive powers to electricity committees, and the proposal had not received much support. If, however, the Watch Committee was given executive powers why should not the electricity committee? There were some committees which had executive powers, and their undertakings were run as economically as—or perhaps more economically than—others. During the discussion only one side of the question had been heard. As to contributions to rates, the companies had to make profits and distribute them, and why should the municipal undertakings be worked on other lines?

Alderman SINCLAIR, acknowledging a vote of thanks, said that although opinion was to-day against the suggestion of giving executive powers to electricity committees, he firmly believed that the time was not far distant when executive powers would be granted because they were necessary.

Messrs. D. H. Bishop, G. Carnegie and T. M. Climie.

Lt.-Col. W. A. Vignoles, Mr. A. E. McKenzie and others.

A party leaving the Opening Meeting.

The Distribution of Electricity in Rural Districts.

(Abstract.)

By H. F. G. WOODS, M.I.E.E.

It is hardly surprising that the rural areas have, in the past, offered little attraction to electrical undertakers as a field for development; in fact, until comparatively recent times the difficulties in the way of such extensions were, in most districts, practically insuperable. New conditions arising out of recent legislation and the rapidly growing demand for electricity for almost every conceivable purpose have now entirely altered the position of every municipality possessing statutory powers, and rendered expedient the early consideration of the extension of their boundaries of supply.

From the point of view of the supply authority, the extension of supplies into country districts is desirable, because experience has gone to prove that the addition of such supplies

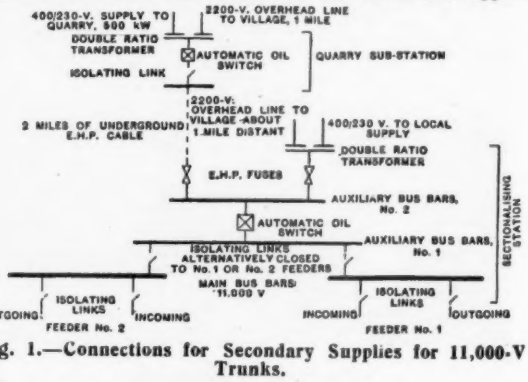


Fig. 1.—Connections for Secondary Supplies for 11,000-V Trunks.

not only tends to increase the sales generally, but, in consequence of the appreciable diversity between the demand of such districts and that of the towns, also tends to improve the load factor of the total supply, with a consequent beneficial effect upon the costs of the undertaking as a whole.

The unification of control and administration over extensive areas is desirable, not only from the standpoint of the supply authority, but also from that of the rural population, which seems generally to prefer that such control should be in the hands of municipalities rather than of companies—particularly where the surplus is not appropriated for the relief of rates.

The fundamental problem underlying any scheme of rural distribution is one of finance. The population to be served is small and scattered, while the possible revenue to be derived from it, in the early stages of development at least, can be but small. While large houses are dotted infrequently about the countryside, the hamlets and villages, where houses are more closely congregated together, are, in general, inhabited by agriculturists, the majority of whom are not the owners of the cottages in which they live, and are not disposed to spend money upon the improvement of their landlords' property. The landlords, on the other hand, are unwilling or unable to spend money on wiring their tenants' houses, for which they

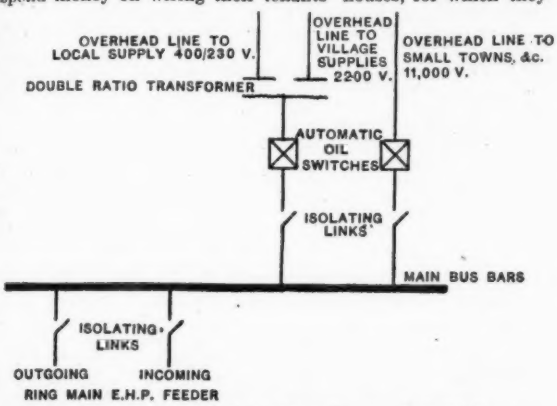


Fig. 2.—E.h p. Control in Transformer Sub-Station.

are not likely to recover any adequate return. This obstacle to electrical development, though perhaps more acute in the country, is one which has always existed in the urban areas, and there is no doubt that it will be overcome with as much success as has already been achieved in many towns. Many farmers now possess their own farmsteads and, in such cases, it is not usually difficult to install a supply, provided that the service costs can be reduced to a sufficiently attractive figure.

It is contended that it is a primary duty of statutory authorities to offer their consumers a full supply of electricity upon terms which enable it to be used, for all purposes, in competition with other methods, rather than to restrict the possible use to lighting by charging high flat rates. To the majority of the rural population, as even now to many dwellers in the towns, the word "electricity" is synonymous with "lighting" and, upon the first introduction of a supply, its use is limited to that purpose by the majority of country consumers.

It is held to be essential to the ultimate financial success of any scheme of rural distribution that consumers should be encouraged by every means to make the fullest use of the supply for every possible purpose.

The present inordinately high prices charged for domestic electrical apparatus of every class is a severe handicap to electrical progress and, until manufacturers can find means substantially to reduce their prices, a hiring scheme is essential to the success of rural development. To secure active development and an extensive use of the supply for domestic purposes, other than lighting and very small power, it is essential that the price per unit charged, in addition to a standing charge should not exceed 1½d., the standing charge being so proportioned as to result, with the unit charge, in an average price, not exceeding tenpence per unit for lighting purposes, based on the assumption that the load factor of the lighting load is eight per cent.

It is suggested that unless a scheme for rural distribution can be so designed that it may reasonably be expected to become self-supporting upon some such basis of charges after a period of three or four years from its inception, it is advisable to postpone its further consideration, pending the development of more favourable circumstances.

The employment of overhead lines for distribution, as well as for transmission, is a necessity imposed by financial considerations in connection with all schemes for the supply of electricity in sparsely populated areas. Conditions of supply and local circumstances vary so widely in different districts that no general scheme of distribution can be laid down as applicable to all. The one general characteristic common to all such schemes is the small revenue obtainable at the outset, and the consequent necessity for reducing capital costs to a definitely limited maximum amount in all cases. To achieve that result it is imperative that the closest attention be paid to the simplification of design, the elimination of every detail that is not essential to secure safety to operators and to the public, and to ensure reasonable continuity of service.

The means of placing rural supplies upon an economic basis are provided by the extra-high-pressure mains linking urban areas, or radiating from them, to supply works, quarries or other large consumers, and it is from such mains that secondary lines can be branched to supply rural districts through which they pass, or which are situated in their vicinity, without unduly heavy capital expenditure being incurred.

When e.h.p. main lines, either underground or overhead, are being planned to pass through country districts, the necessary sectionalising stations should be located in positions suitable for forming distributing centres, from which supplies to neighbouring villages and rural areas can be given. In such cases the cost of switchgear and transformers can be substantially reduced by the use of double-ratio transformers, by means of which the e.h.p. supply can be stepped down to low pressure for giving supplies to residents in the immediate vicinity of the station, and to an intermediate pressure for supplies to more distant consumers and to secondary centres of distribution.

In view of the comparatively small economic range of rural distribution imposed by existing conditions, it is suggested that it is unnecessary, and even undesirable, that the main supply pressure for such distribution should exceed 3,300 volts. Lines working at such comparatively low pressures as 2,200 or 3,300 volts can be readily and inexpensively tapped to afford supplies to individual consumers, while such a system of distribution possesses the additional advantage that the reactance of the transformers interposed between the main transmission lines and the rural distribution lines forms a valuable buffer to protect the primary system from the effects of shocks arising through faults on the secondary lines. The lines in themselves also, at the lower voltages, are less liable to be affected by birds, branches falling across the conductors and other similar causes, which would interrupt the supply on lines operating at higher pressures.

Fig. 1 shows, diagrammatically, the connections of a system of secondary supplies, tapped alternatively from either of two parallel 11,000-volt trunk mains. One main e.h.p. switch only is used to control supplies to local consumers at low pressure.

From a sectionalising station on an underground 11,000-volt trunk main, which is used on a similar system to give supplies, locally, at low pressure, and also at 2,200 volts, to a number of villages and individual consumers scattered over a radius of some two to three miles, an overhead line, working at a pressure of 11,000 volts, is branched to afford primary supplies to three small townships, having populations of from 5,000 to 1,500, and which will be tapped, at suitable points, to afford supplies to the districts along its route. Fig. 2 shows, diagrammatically, the arrangement of e.h.p. control within the station in which the transformer is also installed.

The total capital cost of the station, completely equipped, was £763. Given favourable conditions of supply, the demand of individual consumers in houses of quite modest dimensions may not infrequently be of the order of 6-kW while, in the larger residences a demand of double that amount may reasonably be expected. In such circumstances, it has been found unwise to lay down long low-pressure feeders between the source of supply and the central distributing points, and in most cases the employment of high-pressure feeders is essential to the provision of a satisfactory supply and the extension of remunerative business.

Fig. 3.—Standard Pole-mounted Transformer Station.

In villages where the farms and other residences are separated by intervals of open country, a system of house-to-house transformation, objectionable as it may be in many respects, appears to be the only practical method of giving a reasonably efficient service. Where a village community is supplied by means of a system of l.p. overhead distribution, it has become more or less generally established practice to install the supply transformer, of the out-door type, upon a suitably constructed platform, mounted upon an H-pole at the terminus of the h.p. line.

Such an arrangement can be quite satisfactory for transformers of capacities up to 100 kVA, and has the advantage

that it is simple and inexpensive. A simple standard construction of the type indicated is illustrated in fig. 3; it costs about £40, complete with the H-pole, but without the transformer. A transformer installed upon a suitable base directly upon the ground might at first sight appear to be simpler and less costly or difficult than platform mounting, but the cost is actually little, if any, less, owing to the introduction of cables and the sealing boxes. Transformers of small size, *i.e.*, up to, say, 10-kVA capacity, are most readily and satisfactorily accommodated by being bolted directly upon the line poles.

It is a practice, in the smaller villages, to dispense with any form of protection other than the h.p. fuses on the supply side of the transformers.

With regard to l.p. distribution, it is suggested that it is a wise practice never to erect line conductors of smaller copper section than .07 square inch (No. 1 S.W.G.) from the outset. At a pressure of 400 volts between phases, a line of such a section would have an effective radius of about 800 yards, when supplying a balanced distributed load of 70 kVA. Where, as is almost invariably the case, economic conditions demand that the initial capital cost of a scheme of village distribution be reduced to the very minimum possible, some advantage may be gained by commencing the supply upon a single-phase 3-wire, or an open-V 3-phase system, with a view to changing to a full 3-phase 4-wire system when the demand has sufficently increased to justify additional expenditure. By this means, while the poles must be designed to carry full 3-phase equipment, two phase lines only and a neutral need be erected at the commencement, the third line being added on the subsequent change-over.

In influencing the choice between a single-phase or open-V system of temporary supply, the fact that the latter system allows the adoption of 3-phase motors is frequently the determining factor. Care must, of course, be taken, when motors are installed upon an open-V system of supply, to ensure that both ends of their phase windings are brought out to the terminal board, and that they are suitable for changing from delta to star connection when the full 3-phase 4-wire supply is given. Having regard to the scattered nature of the load, it is not desirable that the copper section of the neutral line should be less than that of the phase lines.

In villages, distributing mains should, wherever circumstances so permit, be run along the roadside in preference to being set back behind houses. Where a street is already monopolised by a multi-wire Post Office line the setting back of the mains over private property may frequently appear to offer a tempting way of escape, but it is suggested that the wiser course is to face and overcome the difficulties of running the mains along the road, even if the only practical solution is to lay them underground. Some day, doubtless, the joint use of poles by electricity supply authorities and the Post Office will be the common practice, but until that day arrives, much money will continue to be wasted by both authorities which by co-operation could have been saved and even mutual economies effected, to the benefit of their respective services.

For distribution in village streets a straight vertical disposition of conductors is held to be neater in appearance and less obtrusive than any other arrangement, and is, therefore, generally to be preferred, in spite of the fact that the cost is proportionally heavier, in consequence of the greater length of pole. In more open country, the lower cost of the horizontal cross-arm type of construction (which amounts to about 12 per cent.) becomes the determining factor.

It is suggested that a high line construction is less conspicuous than a low construction, and that it is, consequently, desirable that the present minimum conductor clearance of twenty feet from the ground should not be reduced in the case of lines erected in village streets. In open country, on the other hand, there seems no logical objection to the clearances being substantially reduced for h.p. as well as for l.p. lines, without the introduction of any increased risk to the public It is certain that the resulting reduction of cost would be a great encouragement to the cause of rural electrification.

It has already been observed that, to authorities who extend their supplies into rural districts, there attaches the strong moral responsibility of avoiding the use of any construction which might have the effect of detracting from the picturesque appearance of the countryside, and it is further suggested that any additional care, trouble and even justifiable expense, incurred to avoid such disfigurement is well worth while.

There is a type of country township in which the circumstances approximate to urban conditions, and where service lines stretched across the main street present an exceedingly unsightly appearance; in circumstances of this kind it is strongly to be recommended that the distributing mains be laid underground.

The choice of pole material is a factor of importance, affecting the appearance of a distribution line. Apart from its comparative cheapness, the wood pole offers no advantage in any respect either from the engineering or the æsthetic standpoint. Reinforced-concrete or tubular steel poles, on the other hand, being manufactured products, may be accurately and neatly constructed to a suitable design and painted after erection to harmonise with their surroundings. It might, perhaps, be contended that, having regard to the much longer life of steel and concrete, and their consequent lower rates of depreciation, the annual charges payable in respect of lines so constructed could be so reduced as to counterbalance the lower first cost but higher rate of depreciation of lines carried on wood poles.

Experience seems to confirm that an average life of between twenty and thirty years may reasonably be expected for properly maintained, impregnated red fir poles and, therefore, the maximum loan repayment period of 25 years allowed by the Electricity Commissioners would appear to be justified.

The conclusion is arrived at that if the loan repayment period were increased to as long a period as forty years in the case of concrete construction, the annual loan charges on such a line would become, approximately, equal to the annual charges on the cost of a corresponding wood pole line, spread over the standard period of twenty-five years; but that, even if the period were increased to fifty years, the annual loan charges, on tubular-steel construction would still exceed the charges on a wood pole construction, spread over the standard period.

There would, therefore, appear to be no justification for the use of any pole material, other than wood, for distribution lines in cases where the annual capital charges are the determining factor. The cost of armoured cable, laid direct in the ground, works out at rather more than twice that of an overhead line of equivalent copper section erected upon steel poles and, roughly, three times that of an equivalent line erected upon wood poles.

Since the greatest of all problems which confront supply authorities in rural districts is the inevitable one of balancing income and expenditure, the following typical example is given with a view to illustrating the kind of results which may be anticipated in the case of a supply, given on the system described above, to an isolated village with 750 inhabitants, scattered over an area of some 200 acres. There is a 2,200-volt 3-phase feeder, having a total length of 1,436 yards, of which 356 yards are, for various reasons, laid underground, and 1,080 yards overhead. The feeder terminates in a pole-mounted transformer station of the type illustrated in fig. 3. The l.p. distributing system is of the vertical construction type and consists of 23 spans of three-conductor line, operating on three-phase open-V connection and totalling 1,214 yards of route length.

The total capital costs and annual charges allocated to the scheme are £1,154 and £91, respectively.

Given reasonably favourable conditions, an average consumption of 850 kWh per consumer per annum may fairly be assumed, say, a total consumption of 60,000 kWh for the year. On that basis, and assuming the application of a two-rate tariff, a kWh charge of 1.131d. should, in normal circumstances, be sufficient to avoid any adverse balance on the year's working. The average kWh charge, under the system of charges actually in force in the village in question, is approximately 1.35d.

The Distribution of Electricity in Cities & Towns & Rural Districts.

Joint Discussion on Mr. L. Romero's and Mr. H. F. G. Woods's Papers.

Councillor STANDING (Aylesbury) said that for the agricultural worker the suggested price of 1½d. per unit was on the high side. As representing a small country town with a supply area of 230 square miles, he was sorry to notice how few municipal undertakings had acquired Parliamentary powers for extended areas of supply; the result was that companies had acquired monopolies over the greater part of the country, and in most cases appeared to have no intention of giving a supply unless they were assured of a fat dividend in the first year. The greater approachability of the tenants in rural areas was an important factor as regarded easing-off their demands during the morning cooking peak and evening lighting peak. As to wiring, he did not share the author's fears that tenants would not do this, because a popular system of hiring wiring and also apparatus would, he believed, bring about the desired results. It was disappointing that the authors had only advocated rural supply in part and not as a whole. In his own area, the Council had taken 100 square miles of the poorest part without a single factory, and a scheme was being got out that would give electricity in every house. From what he had seen of it, and with the help of the revised regulations, he believed it would be financially sound without any question of a 20 per cent. guarantee or paying for the service lines. If properly erected, he did not believe overhead lines would spoil any village, however picturesque, and certainly any village was the better off for having a supply. Running poles over private property should be the subject of compulsory powers, although there was the slight disadvantage of not being able to fix street lamps to them. Finally, as regarded rates, the speaker urged that transmission lines were of the nature of highways and should not be handicapped by high rates.

Mr T. P. WILMSHURST (Electricity Commission) said rural communities were clamouring for electricity, and there were very good reasons for it. Since the war, he was told that in Sweden 40 per cent. of the homesteads and 60 per cent. of the farms in the agricultural areas had been given the benefits of a supply of electricity, and yet the population in Sweden was only 35 per square mile, as against 480 in this country, or 115 for the rural areas. If rural electrification could be made to pay in Sweden under those conditions, surely it could be made to pay with our much higher population per square mile. Referring to the contribution of the Electricity Commissioners to this problem, Mr. Wilmshurst said that in the autumn of last year a Committee was set up consisting of members of Parliament for rural areas, representatives of the Ministry of Agriculture, of the I.M.E.A., of the power com-

panies, the Rural Industries Bureau, the Farmers' Union, and other bodies. That Committee had resolved itself into two sub-committees and their reports would be issued by the end of July. He recommended every chairman and every engineer to obtain a copy, because it would be found to contain some very valuable and stimulating suggestions. The next piece of work the Commissioners had done was, with the help of Mr. Britton, Mr. Turnbull, and other experienced engineers, to revise the Overhead Line Regulations, and it was believed that the new Regulations would reduce the cost of construction by something like 25 or 30 per cent. Then there had been conferences with the Post Office which had resulted in the Postmaster-General agreeing to certain relaxations of his guarding requirements and clearance between his circuits and power circuits. It was only fair to say that the Post Office engineers, who had often been blamed, had been very reasonable and amenable in their dealings with the Commissioners. He had one other announcement to make, relating to what were known as "second-comer" cases; the Postmaster-General had now, with certain stipulations, agreed to bear the whole cost in cases where he was the second-comer. His own opinion with regard to rural electrification was that it was entirely different from urban electrification and must be dealt with on different lines. The people in the rural areas were poorer and would have to be helped in a manner not so necessary in urban areas. In a rural electrification scheme there must be financial assistance for wiring, a suitable department for propaganda, intensive canvassing, demonstrations and exhibitions, and there must be the free use of overhead lines. He saw no reason why rural supply, except in the very poorest areas, should not be self-supporting in three years on the basis of 30 or 40 units per head of population. The consumption should reach 100 units per head; some engineers were too apt to think in terms of lighting and not sufficiently in terms of the other uses of electricity. There must be an attractive two-part tariff. In a scheme under consideration it was undertaken to devote 10 per cent. of the capital raised to the provision of wiring installations and apparatus, to devote 1 per cent. of the revenue to propaganda development, and to provide free services from overhead lines.

Mr. C. W. SALT (Carlisle) remarked that the charge of 1½d. per unit mentioned in Mr. Woods's paper was lower than the average of a very large number of towns and cities, and there might be some difficulty in getting down to that figure, considering the extra capital outlay on the greater distance of transmission. He had been going into a scheme dealing with 100 square miles at a cost of £100,000, of which £35,000 was for local distribution, and it seemed that rural distribution would cost three times the figure realised in more populous places. As suggestions for easing the financial position of rural supplies, Mr. Salt said there might be some flexibility in the matter of the compulsory period for laying mains within two years, as well as in the voltage variation limits, both of which would help to reduce the capital outlay. Money might be saved on large rural supplies by tapping off the Central Electricity Board's 33,000-volt lines in order to avoid having two networks in one area where one would serve the double purpose. It would assist if the Board would announce its policy as to the smallest capacity it was prepared to tap off.

Mr. G. PORTER (Worthing) spoke upon the question of distribution in small towns, and said it was necessary now to look a long way ahead and make provision for ample mains. It was no use thinking of little mains in a small way. From this point of view standardisation of distributing mains was very necessary, and these should be classified according to the nature of the street. The change-over from d.c. to a.c. was a serious problem and a very expensive one; some figures he had worked out showed that it would cost from £6 to £7 per consumer, and in Worthing that meant £40,000. Then there was the trouble from wireless sets connected direct to the supply mains. These were a great nuisance, and stringent regulations ought to be made with regard to them, not only because of the potential danger to the users in the case of headphones, but because of the disturbance they caused on the supply system. Speaking generally on the question of the change-over from d.c. to a.c., Mr. Porter said that cables would stand up better and his vulcanised-bitumen-jute-insulated cables would be considerably increased in life by the change-over. The question, however, was whether it was worth making the complete change at once, or whether it would not be better gradually to superpose an a.c. system on the existing d.c. system; he believed the latter would be the best policy in many cases. Voltage variation certainly created difficulties if lines were to be run out into the country and electricity was to be supplied at low rates. As a matter of fact, engineers were extremely uncertain as to the difficulties arising out of the 1926 Act, and he did not think there were many who would be happy about their plant next winter. A position has arisen when plant was being worked almost up to the hilt and the brake was being put on development because of the fear of what might happen under the Act. It was therefore to be hoped that the Central Board would get busy with its lines and also invent some quick method of dealing with the wayleave problem. With regard to mains in rural areas, Mr. Porter expressed a belief that underground mains could be laid and operated ultimately as cheaply as overhead lines. An area around Worthing had been developed in this way at a cost of £60,000, and it had been estimated that it would take five years to be self-supporting, but so rapidly had the demand come on that it was self-supporting at the end of the second year.

Mr. A. J. HOWARD (Taunton) urged the need for a still further revision of the Electricity Commissioners' recently revised Overhead Line Regulations, and quoted heights of loads on farms and the heights of main road bridges in support of the view that the heights of poles as now fixed were too high and could safely be reduced. His considered opinion was that the revised regulations still went far beyond what was required. Another matter was the delay and expense in getting plans through. Although he had carried out a lot of rural electrification he could not see much money in it, but he hoped Mr. Woods's optimism would be justified. Referring to the Post Office engineers, Mr. Howard said he found the local engineers very amenable and reasonable, but the picture altered when one got into communication with London.

Mr. E. SEDDON (Edinburgh) said it would never be possible to give a cheap and abundant supply of electricity in rural districts unless there was some sacrifice in refinement as regarded pressure regulation, which at present involved extravagant expenditure on copper. On the question of tariffs, they were getting into such a maze that the public did not understand what was being aimed at. What was required was a two-rate tariff framed in such a way that there would be a reasonable fixed charge and a low rate capable of general adaptation. In Edinburgh a six-roomed house was generally reckoned at 300 units for lighting per annum, and the tariff was so arranged that the consumer had the first 300 units at the lighting rate and then all subsequent units at ½d. per unit. This encouraged people to make extensive use of electricity for purposes other than for lighting. The original installation in Edinburgh was d.c. three-wire, but some years ago the length of d.c. mains became so great, and so much pressure was being lost, that it was decided to ring the whole city with static sub-stations of a standard type, containing five panels and two transformers arranged in such a way that the centre panel of the five was a bus-bar coupler and the connections were such that whatever happened on the system the district was assured of a supply.

Mr. S. SWARBRICK (Basingstoke) said the figures in Mr. Woods's paper did not come out well for armoured concrete poles. The regulations with regard to concrete poles were now under consideration, but as they existed they provided for a factor of safety of 3½ based on the yield point and not on the ultimate strength—in addition to the factor of safety for ice loading—and this very greatly increased the cost of construction. In countries where the regulations had done justice to the mechanical and economic features of reinforced concrete poles, they had made great headway. Germany had 100,000 concrete poles in use, and France had over 500,000. The cost of a French pole, made in sections for convenience of transport, and built to comply with the French Mechanical and General Lines Regulations—based on experience with over 40,000 miles of e.h.p. overhead line—was about 34s., or delivered to a South of England railway station, £3, the weight being about 1,000 lb. A post to comply with regulations for some recent Continental designs would cost here about £5 8s. A much longer span could be handled at a slightly increased cost per post, but the total cost would be materially reduced. It was a pity that a potential industry using unskilled labour, British cement, and British steel, was unable to begin its existence because of adverse regulations. Speaking upon wayleave forms, Mr. Swarbrick said the I.M.E.A. form was excellent from a legal point of view, but there were too many blanks to be filled in, and the general characteristics of it were such as to encourage landowners to consult their solicitors too much.

Mr. S. G. MARSTON (Stockton-on-Tees) said that seven years ago in his town a change was made from the d.c. system to a three-phase four-wire system. Since then roughly £23,000 had been spent on plant and £100,000 on development in a town having a population of approximately 70,000. The three-phase four-wire system was at 40 cycles, and it now seemed that he was to be faced with the expense of changing over to 50 cycles. The geography of the town was such that radiating mains from the centre was practically the only possible arrangement and this scheme had been carried out. Later it was hoped to fill in the rim of the wheel so that a duplicate supply could be given everywhere. The suggestion that each sub-station should have two transformers was ideal, but it was not always practicable. In his own case he had one transformer, but provision was made for feeding on the l.p. side if anything happened to the high-pressure side. There was no high-pressure switchgear in any of the sub-stations, each high-pressure feeder and transformer being treated more or less as one. There were four or five outdoor sub-stations, standing on concrete platforms, but without any high-pressure switchgear, although there was space for it if required. It was his practice in small houses to run the service in on a partition wall and loop-in when the second house wanted the supply. As regarded load factor, he had found it difficult to persuade his committee to sell electricity at less than the average cost, and also to get the committee to grant concessions to good consumers. He asked the industry, the electrical Press, and the I.M.E.A. to put a limit upon the number of questionnaires sent out regarding kettles, irons, curling-tong heaters, and so forth; it was an utter impossibility to fill them in.

Mr. S. E. BRITTON (Chester) said the psychology of the rural people was different from that of urban folk, and in tackling them it was necessary to know quite a lot of other things besides electricity. For instance, it was essential to be able to discuss milk and cows and pigs, and so on. There was also some overlapping between districts, and what might

at first sight appear to be a rural district was really a semi-urban district, which also had to be tackled in its own special manner. He did not agree with Mr. Woods that power companies had done more to develop rural supply than the municipalities. The fact was that power companies went through rural areas because there was a good industrial load at the end of the line, and they were then able to give a supply in the rural areas. He regretted that local authorities had been so slow in developing the outer areas of their districts, as he feared they had lost the opportunity for ever. With regard to the suggestion of Councillor Standing, of Aylesbury, that he was aiming to give everybody a supply, he thought that must result in failure, because he believed that in an area of 200 or 300 square miles 75 per cent. of the population was the most that it could be hoped to supply profitably. Speaking of the recent relaxation of the Commissioners' Regulations, he thanked the electrical Press for the manner in which it had assisted the industry in the matter of legislation.

Mr. R. W. L. PHILLIPS (Bedford) urged the municipalities to acquire as much rural territory as they could in the immediate neighbourhood of their districts. His own Corporation had acquired some 200 sq. miles, and he was very thankful it had done so early, as it had been of great assistance to them politically in regard to the land-grabbing policy of the companies, backed by a copious flow of American capital. His experience was that underground cables for rural areas near to large towns worked out at not much more, if any, than the cost of overhead lines. His figures showed a highest cost of £900 per mile, and Mr. Woods gave from £600 to £700 per mile for overhead. Certainly the suggestion that underground cables cost three times as much as overhead lines was not his experience. There were many villages which already had a Post Office line criss-crossing down the main street, and further power wires would certainly spoil them. Already 36,000 yards of underground cable had been laid in villages near Bedford. A company operating eight miles away had completely spoiled the appearance of one village with overhead wires, and as a result the whole countryside was up in arms. As regarded tapping from the Central Board's high-pressure lines, the Board had laid down a minimum of 10,000 kW for the 132,000-V lines, and he believed that the cost of each tapping would be £40,000.

Mr. J. K. BRYDGES (Eastbourne) remarked that the effective remedy for preventing explosions in pits was good ventilation. He had endeavoured to prevent gas coming in by closing the boxes with a non-hardening putty, but that was only partially successful, although there had been no explosions. Owing to the difficulty in securing sites he had been compelled to build an underground sub-station 30 ft. by 30 ft., half under the roadway and half under the pavement, to contain some 2,000 kW of transforming plant and high-pressure switchgear. Referring to services, he suggested that perhaps the Commissioners would issue a ruling to the effect that services should be provided free. A great many of the telephone wires were being placed underground, which meant that a large number of good poles would be available. Could they not be left in position and made use of for local power distribution? Mr. Salt had mentioned tapping the 33,000-V lines—not the 132,000-volt lines, as Mr. Phillips seemed to think—and the possibility of tapping such lines was a point upon which an answer from the Board would be useful.

Mr. WOODS, in reply to some of the points raised, said he did not see how the average price per unit could be brought lower than 1½d. per unit at present. He warned Mr. Standing to go carefully with his scheme for supplying everybody, otherwise heavy losses might be incurred. He thought there was no reason to be despondent, especially having regard to the active policy of the Commissioners, outlined by Mr. Wilmshurst. Everything, of course, depended upon the district. As to wayleaves, everything seemed to be a matter of bargaining. With regard to the use of reinforced concrete poles, he did not think the lengthening of the span by such construction was an important matter, because in village work it was necessary that the span should be short, owing to the lay-out of the streets and the necessity for taking off services at frequent intervals. Whatever the power companies had done and the reasons why they had done it, the fact remained that there was something remunerative at the end of the rural lines, and the rural areas had benefited as a result. Mr. Phillips was fortunate in being able to supply his villages by means of underground cables; in the speaker's area the cost would be prohibitive.

Annual Dinner.

The annual dinner of the Association was held on Thursday, June 14th, at the Pump Room. The demand for seats exceeded the capacity of the largest room available, so two rooms were occupied, Mr. F. W. Purse presiding in the Concert Room, and the vice-president, Mr. A. Nichols Moore, in the Old Pump Room; messages of goodwill were exchanged, and some amusement was caused by the latter chairman referring to the president's company as "the overflow." Altogether about 280 members and guests, including many ladies, sat down, amongst them being the Mayor and Mayoress of Bath, the Mayor and Mayoress of West Ham, Ald. Sir Harry Hatt and Lady Hatt, Sir A. R. Duncan, Lady Snell, Sir I. M. Gatti, Mr. Archibald Page, Mr. T. P. Wilmshurst, Lt.-Col. W. A. Vignoles, D.S.O., Ald. W. Walker, Dr. S. Z. de Ferranti, Mr. Arthur Ellis, Mr. H. C. Lamb, Mr. R. A. Chattock, Mr. Ll. B. Atkinson, and Mr. A. C. Cramb.

After the loyal toast, Sir ANDREW DUNCAN (chairman of the Central Electricity Board) proposed "The I.M.E.A." He said he had read the presidential address very carefully, and was pleased to find in it a disposition to put controversies aside and give the Board a fair chance. With forbearance, goodwill and square dealing there would be ample opportunity for them to work in the closest harmony.

Responding, Mr. F. W. PURSE expressed appreciation of the compliment Sir Andrew had paid them by coming to Bath to propose that toast—an expert diplomat, he had won them all over. They were anxious to help the Board, but were not always helped to do so—a West Ham proposal for electrical development on a large scale had waited 18 weeks before it was announced that an inquiry would be held. He referred to the untiring labours of the hon. secretary, Mr. A. C. Cramb, and paid a feeling tribute to the assistance and encouragement he had received throughout his career from Mrs. Purse.

Councillor J. H. Inskip, of Bristol, proposed "The City of Bath and County Borough of West Ham." The Mayor of Bath responded, and the Mayoress (Madame Sarah Grand), in a brief speech, remarkable for its perfect enunciation and strong delivery, expressed the wish that electrical devices should be brought within the reach of every housewife in Bath. The Mayor of West Ham (Ald. Morris Streimer, J.P.), also responding, claimed that his borough had its beauties—infant welfare was sedulously cultivated, and the electricity undertaking would bear comparison with any in the country.

Mr. C. G. Morley New (Cardiff) proposed "Ladies and Other Visitors," pointing out that their own prosperity was bound up with that of the Central Electricity Board, and Miss C. Haslett (Director E.A.W.), responding, expressed thanks for the help given to the E.A.W. by the I.M.E.A., and especially by Mr. A. C. Cramb and Miss Lanfear. Mr. Arthur Ellis (Cardiff) also responded on behalf of the guests.

In the other room, Mr. T. R. MARTIN, of Birmingham, proposing "The Association," said that the ability of the Association to rise to its responsibility was a question of national importance. Out of 282 bodies eligible, 246 were already members, and therefore the Association was thoroughly representative of municipal electrical undertakings. The Electricity Bill was law, and they hoped it would turn out in the way the promoters promised, and with that hope the manufacturers and other constituents of the industry would give the Association all the support they could. On the question of standardisation, he asked engineers always to bear in mind that this country must continue to be an exporting country.

Mr. NICHOLS MOORE, responding, agreed that the I.M.E.A., was the most important electrical association which held a convention, and he suggested that its influence in matters affecting electricity supply was never more clearly exemplified than during the past 18 months or two years since the 1926 Act appeared, an influence that was very marked and fully understood by the opposition. Its further influence depended essentially on its having a consolidated and co-ordinated policy. Thanking Sir Harry Hatt, he said that the present Convention was one of the most successful ever held.

Ald. J. W. LONGLEY, of Bradford, submitted "The City of Bath," and said their thanks were due to the City of Bath and Sir Harry Hatt for a very pleasant week.

Sir HARRY HATT replied, saying that he had been for 25 years engaged in spreading the light, and he wondered whether he was not the oldest chairman of an electrical undertaking in the country.

Mr. H. C. LAMB, of Manchester, proposed "The Ladies and Other Guests," and Mr. I. V. ROBINSON, of the British Electrical and Allied Manufacturers' Association, responded.

During the evening the President announced that Mr. G. Preece had won a challenge cup presented by Mr. G. P. Dennis for a golf competition at the Convention, with a score of 70 net, Messrs. Robinson and McKinstry being next with 74. Mr. Robinson had won the "sweep," and the fees, amounting to £7, would benefit the I.E.E. Benevolent Fund.

Annual General Meeting.

The annual general meeting was held on Friday, June 15th, when Mr. A. Nichols Moore (Newport, Mon.) was elected president, and Mr. J. K. Brydges (Eastbourne) vice-president. The hotel accommodation in Newport is insufficient to permit of the Convention being held there next year, and a meeting-place will be chosen by the Council in due course.

Mr. J. H. Rothwell (Town Clerk, Brighton) was elected hon. solicitor in succession to the late Mr. P. M. Heath, of Manchester, and a cordial expression of thanks was offered to Mr. J. Basil Ogden (Town Clerk, Bath) for acting as hon. solicitor during the Convention. Mr. A. C. Cramb and Mr. H. Faraday Proctor were unanimously re-elected hon. secretary and hon. treasurer, respectively.

The action of the Council in electing Lieut.-Col. W. A. Vignoles (director, E.D.A.) an hon. member was confirmed. New members elected to the Council were as follows:—*Engineer members, large undertakings*—W. J. Bache (Cheltenham), A. S. Blackman (Sunderland), S. Clegg (Lincoln). *Small undertakings*—G. Douglas Coe (Hereford). *Councillor members*—Councillor H. K. Beale (Birmingham), Alderman W. Walker (Manchester).

The Council's report for the past year was adopted.

The Institution of Civil Engineers.—III.

Celebration of Charter Centenary, and Engineering Conference.

Railway Design and Maintenance as Affected by the Application of Electricity.

(Abstract.)

By GEORGE ELLSON, O.B.E., M.Inst.C.E., and ARTHUR REGINALD COOPER, M.Inst.C.E.

The provision of clearance for the overhead contact wire under bridges and other structures will necessitate in many cases either drastic alterations to the gradients of the line or the rebuilding of the structures. Overhead equipment brings about special difficulties with regard to the supporting structures and by reason of the interference of such equipment with the sighting of signals. After the preliminary investigation of the general scheme of electrification, detailed consideration of the whole of the track becomes necessary. Standardisation of the permanent-way equipment will often be carried out, and a general review made of the track conditions in order to anticipate the necessity for relaying or any other work.

To avoid leakage and electrolysis, improved standards as regards the type of ballast employed and the drainage provided are desirable on electrified railways. Bull-head track in electrified sidings is to be preferred, since the insulators will be too low to be really effective if flat-bottomed track rails of light section are used.

It is often claimed for the rail located on the cess side that there are fewer interruptions in the continuity of the contact, and that the 6-foot is the most suitable place for handling and depositing material and tools. The main disadvantage of a rail on the cess side is said to be that men have to step over it when getting clear of the track, but this appears soon to become a habit with them.

The provision of suitable clearance for the conductor-rail may require special measures on under bridges, where the rail level may have to be raised and regraded, and where insulation may have to be provided to prevent the shoes from coming into contact with metal structures, especially where the rail has to be interrupted. Where clearances are small the normal conductor-rail may be carried through in an out-of-gauge position, thus acting merely as a conductor, or a short length of shallow section may be used. Signal and telegraph equipment will have to be diverted to clear the conductor-rail and collector-shoe. Where a large measure of protection is thought to be necessary, double boarding is used, a single board on the outer side being sufficient in other cases. These boards are supported either from the rail or direct from the sleeper. It is difficult to say to what extent the protection should enclose a conductor rail at 1,500 volts, and it may be that the present form of rail, with the addition of protection boards each side extending a short distance below the rail, will be considered sufficient.

With the advent of electric traction, current is available along the railway for subsidiary purposes, lighting of stations, and workshops. The installation of electric signalling and electric point operation is encouraged, giving better working and economy. Steam pumps, the maintenance and operation of which are costly, can be replaced by automatic electric pumps. It is customary to provide rubber gloves for use when required, and in certain cases rubber mats are supplied to all permanent-way gangs. Up to the present no fresh type of tool appears to have been introduced to reduce the likelihood of short-circuits, with the exception of the issue of specially narrow shovels on certain electrified sections.

The lower centre of gravity of electric stock, the smaller diameter of the wheels, and other factors, contribute to increased rail-wear. More side cutting takes place on high rails of curves with electric working, and on some lines a reduction of superelevation has been found to reduce this side cutting. Improvement has also resulted from a small widening of the gauge. Irregular wave-like wear at the side of the rail has occurred both on the straight and on curves. On the Underground Railways irregular wear on the top of the rail takes place on sharp curves, and if the rail is not unduly worn as regards total depth, it is planed and reinstated. Manganese-steel is used to a limited extent to meet conditions of abnormal wear, but it is costly, and there is a wide field for a rail steel having better wearing qualities than ordinary hard steel, at a reasonable cost. Any steel used for track rails should have satisfactory electrical conductivity; manganese steel is unsuitable in this respect.

Relaying can generally be carried out without breaking the conductor-rail bonds, and often these rails are not moved at all, temporary supporting blocks being placed between the sleepers. If the conductor-rails must be displaced, they can be moved and replaced without breaking the bonds. On the Southern Railway the new sleepers carrying insulators are inserted before the old track is removed.

Discussion.

Mr. A. NEWLANDS, speaking on the question whether the conductor rail should be in the 6-ft. way or in the cess, said there had been no objection in either case from the point of view of permanent-way maintenance. He preferred to provide the men with rubber handles and covers for their tools, which had to be put on every day, as this made them aware of possible danger, and reminded them constantly of it. He preferred to attach the protective planking to the rails rather than to the sleepers, but he thought they might yet see the end of planking altogether. For pressures higher than 650 V he would prefer overhead collection, because this minimised the difficulties of track maintenance, and there was always a more intensive use of the track under electrical conditions. The increased cost of maintenance of electrified track was in some measure due to the greater use of the tracks under electrical conditions, and that point was often overlooked when making comparisons.

Mr. JOHN WILSON, chief electrical engineer to the Buenos Aires Western Railway, gave a few details of that line, which is one of the two British railways in foreign countries which have been electrified. It had a broad-gauge track, and there were 36 km. of route mile aggregating 125 km. of single line. The voltage adopted was 800 V, d.c., and as there was a large amount of trespassing on the line, an under-running conductor rail had been adopted with a top wooden protection; this method had proved completely satisfactory. At present 130 trains per day were run into Buenos Aires and 130 trains went out, the inward trains arriving at one platform and the outward departing from another. The maximum was 11 trains per hour, but it would be possible to run 20 trains an hour from the same platform. The third rail was normally in the 6-ft. way, but there were lengths of line where it was in the cess. Manganese-steel had been used for special work at terminal stations, but owing to the higher electrical resistance of this section of the track, either he had laid down an additional negative cable jumping across that particular section, or additional rails had been laid in the centre of the track to improve the conductance. The electrical work had been carried out, originally, by the electrical section of the permanent-way department, but since then the electrical section had become a department which was responsible for the testing of all the bonding of the tracks, and the permanent-way department maintained them up to a standard set by the electrical department.

Mr. JOHN GRESLEY also expressed the view that for pressures above 650 V overhead collection was the better and safer system, and thought it would be useful to make this distinction between the higher and the lower voltages to facilitate inter-running, owing to the difficulty of third-rail collection with 1,500-V locomotives. With an overhead collection for the higher voltage, the motors could run in series, in pairs, at the higher voltage, and in parallel at the lower voltage, the switch controlling and paralleling being interlinked with a pantograph arrangement, thus making it a simple operation to go from one class of line to the other. Although the under-running contact rail was safe enough, there was danger from the workmen's tools catching underneath. In this country, however, we could not use it, as such a type of rail did not exist in the English gauge. The testing of the bonding should be carried out by the electrical department, and where there was overhead collection the maintenance of this was so special that it should be in the hands of a separate gang of maintenance men under the control of the electrical engineer.

Mr. EDWARD WILSON thought the conductor rail should be in the cess, except through stations, when it should be in the 6-ft. way, where it was safer from the point of view of anybody falling off the platform. As regarded electrical maintenance, he thought track bonding should be under the supervision of the signal engineer, but the bonding of the conductor rails should be in the hands of the permanent-way department.

Mr. ELLSON, who replied to the discussion, thought that the choice of overhead or third-rail conductors would rest upon cost. For low voltages the cost of the overhead system would be such as to put it out of consideration. He thought Mr. Gresley would find that an under-running contact rail could be obtained in the gauges in this country. On the Southern Railway the conductor rail was in the 6-ft. way in the stations and in the cess in other parts, for the reason mentioned by Mr. Wilson. Also, on the Southern Railway insulated tools were used, although if it were found they were not necessary the practice would be discontinued. At the moment, on the Southern Railway, the divisional engineers maintained the conductor rails, the bonding of the track and the bonding of the conductor rails under the supervision of the electrical engineer. He did not know whether that was altogether the best system, and he was contemplating making a change, as he felt it would be better for the maintenance of the conductor rails and all appurtenances due to electrification to be in the hands of a special staff administered possibly from the Head Office, working in close conjunction with the civil engineer. By having part of the work under the supervision of the electrical engineer and part under the civil engineer there might not be sufficient co-ordination to ensure efficiency, and if all the work was under the civil engineer that appeared to him to be the ideal arrangement.

The Properties of Materials for Use at High Temperatures, with Special Reference to Boilers for Superheated Steam.

(*Abstract.*)

By R. G. C. BATSON, M.Inst.C.E.

It is now generally recognised by engineers that if the steam-engine is to compete effectively with the internal-combustion engine the initial temperature of the working fluid must be considerably higher than that which has hitherto been customary. In the development of steam plant to meet these conditions the principal limiting factor is the strength, at these temperatures, of the material used. Modern steam-plants employ an inlet temperature of about 400 deg. C., and from consideration of the properties of ordinary mild steels at high temperature, a temperature of this order appears to be a maximum. Professors A. L. Mellanby and William Kerr have expressed the opinion that 480 deg. C. (896 deg. F.) represents an upper limit of temperature in the near future, even allowing for fair advance by the metallurgist.

Boiler-pressures have advanced in recent years for the larger land plants from 200 to 800 lb. per sq. in., with a few cases of much higher pressures up to 1,570 lb. per sq. in. In this direction Professors Mellanby and Kerr, starting with an upper limit of temperature of 900 deg. F., have deduced from considerations of thermal efficiency that although "there is little indication of any real pressure limit . . . the period of rapid improvement with pressure is within the first 1,000 lb. of increase" and "1,250 lb. per sq. in. must be close to a true upper limit."

Mr. John Anderson stated that the maximum temperature to which boiler-tubing of 0.16 per cent. carbon-steel, with a yield stress of 20 tons per sq. in. and an ultimate tensile strength of 25.9 tons per sq. inch, could be subjected without failure was approximately 480 deg. C. It is known that this type of steel would have an ultimate tensile strength (when obtained in the usual way) at 480 deg. C. of about 20 tons per sq. in., which would appear to give a reasonable factor of safety. Recent research has shown, however, that the tensile strength of materials at high temperature, obtained by the ordinary methods of testing at air-temperature, is misleading. It has also been found that at high temperature a stress much lower than the ultimate tensile stress will cause failure of any material if prolonged for some time. This is due to creep or flow of the material with time. Further, it has been shown that for each temperature there is a stress below which the material will not fail or will last for many years. This stress has been called the limiting creep stress.

Two conditions are met with in design:—

(*a*) Where no permanent deformation is admissible.

(*b*) Where permanent deformation can be allowed provided failure does not result.

There is probably a temperature where the maximum stress for both conditions is coincident, that is to say, where, if permanent deformation occurs, failure results. On the other hand, at a lower temperature permanent deformation can occur without failure. This is due to the fact that at such a temperature the material "strain" hardens under stress and temperature, owing to creep or flow without appreciable softening, and the creep ultimately ceases, whereas at a higher temperature there is appreciable softening and flow continues.

It does not necessarily follow that the limit of proportionality obtained in the usual way at high temperature gives the stress for condition (*a*). The test is carried out in less than an hour, and creep may occur at such a low rate that it is not perceptible during the test.

It is clear that if working-pressures and temperatures are to be raised much above their present limits, say, 800 lb. per sq. in., materials other than those now employed must be used for boiler and superheater tubes. For this purpose a material is required which will give the mechanical and physical properties at 500 deg. C. obtained with the present low-carbon steels at 400 deg. C., but with no (or very small) addition to the cost. That is to say, a limiting creep stress of about 13 tons per square inch is required at 500 deg. C., with good ductility at normal temperature.

Discussion.

During the discussion on the paper it was pointed out that the limiting creep stress figures referred to in the paper would probably take about four months to obtain. This would be a great disadvantage, and it was suggested that tensile-strength tests would no doubt meet the requirements and would only take a matter of hours. Steels were now available which actually gave the 13 tons per sq. in. creep stress figure suggested by the author.

One speaker said that the outcome of the continually increasing demands that were being made on modern materials would be that we should have to be content with a comparatively short life of the materials. Steel makers had achieved great success in producing alloys with up to 60 per cent. of iron. It was also suggested that the possibility of welding, in particular, superheater tubes should be investigated.

The Utilisation of Solid and Liquid Fuels.

(*Abstract.*)

By CECIL HOWARD LANDER, D.Sc., M.Inst.C.E.

According to present practice and knowledge, coal or other fossil fuel as extracted from the earth has no availability until labour of some kind has been applied to it. Even when it is mined and delivered, its heat units are generally less easy to direct into useful channels than those of gaseous fuels or motor spirits which are therefore of higher availability.

The various pre-treatments which are applied, say, to coal, and occasionally even to oil, consist in bringing about outside the boiler-furnace some of the reactions which under normal conditions may go on within the furnace. Any advantages obtained by processes of pre-treatment are due to the fact that these reactions can be kept under more definite control and products obtained which can be finally utilised with higher commercial efficiency.

It is frequently stated that it is uneconomical to burn fuel in its raw state; but this is at the best only a half-truth, and since any pre-treatment cannot possibly have a 100 per cent. efficiency, it must involve heat-losses in addition to those within the boiler-furnace. Sir George Beilby pointed out, for instance, that the efficiency of a low-temperature carbonisation process amounted to about 80 per cent., and that the deficit would have to be made good by utilising the products of the carbonisation within the final burning-appliance, furnace or internal-combustion engine, with higher commercial efficiency.

The most important source of fuel in the world is coal. In its passage from the solid stage to the flue-gas stage the whole range of products from solid carbon to liquid molecules and gaseous molecules are involved. Modern boiler-furnaces can probably extract and make definite use of a greater proportion of the initial energy of the coal than can any series of processes involving pre-treatment before final combustion. The justification for such pre-treatment thus requires the possibility of monetary savings in other directions. It is impossible to generalise in such circumstances, for the extent to which pre-treatment can be economically applied depends very largely upon local conditions.

Perhaps one of the most interesting developments of the last few months has been the application of pulverised coal to marine propulsion, the United States Shipping Board S.S. *Mercer* having successfully accomplished voyages across the Atlantic on this fuel. The vessel is bunkered with ordinary coal which is pulverised on board in unit pulverisers. Stoke-hold labour is thus reduced, but trimming is still necessary. In other systems the delivery to the bunkers of fuel already pulverised is advocated.

Discussion.

Prof. LEWIS pointed out that labour, capital and administration all had to be expended on coal, and any two without the third were not good enough. To speak of coal as one substance was incorrect, and until they were decided on this point not much progress would be made; they must bear in mind that it was necessary to treat each of its constituents separately with regard to its applications.

Mr. J. H. NARBETH pointed out that in modern practice 1 h.p.-hr. could be obtained for a consumption of 0.4 lb. of oil in a Diesel, 0.8 lb. of oil under a boiler, and 1.2 lb. of coal under a boiler. He did not think the use of pulverised fuel on board ship would be a success, as it required too much valuable space; there was also the danger of storing pulverised fuel.

Mr. W. CULLEN showed that it was not necessary to store pulverised fuel on board ship—the fuel could be taken on board in its ordinary form.

Another speaker thought that pulverised fuel had not received the attention it should, and he suggested that steps would have to be devised to reduce the size of the combustion chamber. There was great need for research in this connection. In the present designs of combustion chamber the flame saw too much black wall. Under ideal conditions there would be no black wall.

Prof. DRON said that efforts should be made to see what use could be made of fusine. While this had a high ash content, it had a higher calorific value than some coal with a low ash content.

Exhibition of Apparatus.

The exhibits displayed in the library of the Institution during the Centenary celebration proceedings were arranged largely with a view to contrasting the conditions obtaining in 1828 with those of the present day. The Elder Brethren of Trinity House showed, amongst other items, an arc lamp of 1862 and a 4-kW gasfilled incandescent lamp. The Science Museum lent a Gramme dynamo of 1870 and a Siemens dynamo of 1873. A feature of the Science Museum exhibits was a model of the La Tuilliere barrage situated on the River Dordogne, France, for the hydro-electric station. Mr. Sherard Cowper-Coles showed samples of iron protected from corrosion by his process, and the Cambridge Scientific Instrument Co. exhibited a thermograph.

An interesting exhibit was that of the Central Electricity Board, comprising models of steel towers, a model of a proposed 132-kV outdoor sub-station for use in connection with the "grid," and a plan of the scheme of extra-high-pressure transmission lines for Great Britain.

Messrs. Hadfield's, Ltd., had on view a comprehensive collection of their specialities, including various magnetic alloys, cobalt magnet steel with a coercive force of 220 units, steels of low hysteresis, and the original experimental transformer with which the saving in hysteresis was demonstrated. A machinable non-magnetic steel of high yield strength was shown, and a variety of steels for turbine blades, capable of resisting corrosion and unaffected by high temperatures.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A Domestic Refrigerator.

The restrictions set out in the new Food Act as regards the preservation of food stuffs give prominence to the importance of domestic refrigerating equipment. Fig. 1 shows the "Selco" domestic refrigerator which has recently been introduced by Messrs. S. G. LEACH & CO., LTD., 26-30, Artillery Lane, E.1. Its principle is simply that of boiling a refrigerating liquid

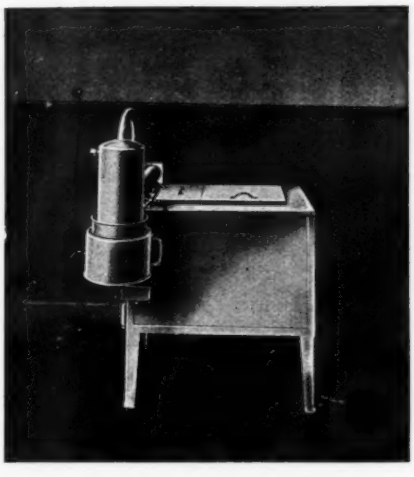


Fig. 1.—The "Selco" Refrigerator.

which, when vaporised, absorbs the heat from the cabinet and so maintains it at a temperature below 50 deg. F. for 24 hours. The apparatus is suitable for electrical operation and the heating period is less than an hour; the loading is 1,300 W. There are no working parts. Cooling water is circulated only during the working period.

An Electric Soldering Iron.

The "Trump" electric soldering iron, a product of the ARDEA VULCANIZER SYNDICATE, LTD., 318, King Street, Hammersmith, W.6, embodies, it is claimed, a new departure in the construction of its heating element, which is built on the lines of an electric radiator element. The element is porcelain insulated and wound with a stout-gauge wire. It is of the slip-in type, so as to facilitate repairs. The iron is made in three sizes with loadings of 220, 200 and 180 W, and bit diameters, of 1¼, ⅜ and ⅛ in., respectively.

A New Electric Fan.

An electric fan of attractive appearance and novel design which has recently been placed on the market by the REVO

Fig. 2.—The "Elite" Fan.

ELECTRIC CO., LTD., Britannia Works, Tividale, Tipton, Staffs., is shown in fig. 2. The feature is the absence of harsh mechanical lines which, with a delicate finish of glossy white with gold lines, renders the fan an ornament wherever it is placed. Looking at the front of the fan, through a guard of crinkled brass wire, only the blades of polished brass can be seen. The motor is entirely cased in, but it can be exposed for inspection by simply removing two screws. It has a polished brass stand which can be adjusted and the fan set at any angle. At the present time the fan is supplied with 10-in. guards and blades. D.c. models have loadings of 25-35 W and a.c. models 30-40 W, in each case for voltages from 100 to 250.

An Improved Fuse.

Since the introduction of the "Empire" s/c fuse, a product of Messrs. ELECTRIC CONTROL, LTD., Hastings House, Norfolk Street, Strand, W.C.2, considerable improvements have been made in its mechanical design and construction. The sealing of the brass ferrules on to the glass tube is now accomplished with a metallic alloy, an achievement which involved the development of a satisfactory means of sealing

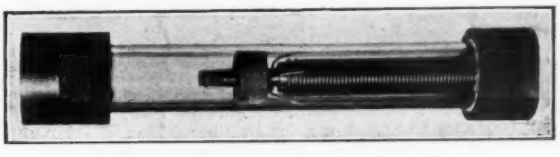


Fig. 3.—An "Empire" Fuse—"Blown."

the junction of two materials of widely different thermal expansion characteristics. Soldered joints are now entirely eliminated and replaced by mechanical connections. Experience has also led to improved methods of manufacture and of testing and handling the glass tubes and the special liquid used. It is interesting to learn that the manufacturers have recently instituted a scheme of recharging and reconditioning "blown" fuses free of cost for a period of three years from the date of dispatch. Fig. 3 shows an "Empire" fuse after "blowing."

Dual-Frequency Motors.

With a view to facilitating the problem which confronts both consumers and supply authorities in those areas where the supply frequency will be changed from 25 to 50 cycles, the ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2, has introduced a range of "Dual-frequency" motors which, it is claimed, will give substantially the same performance on either of the frequencies. The motors can be supplied with squirrel-cage or slip-ring rotors, according to the output and service conditions, and the "change-over" is a simple matter of changing the connections in the terminal box. The general appearance of the motors is the same as

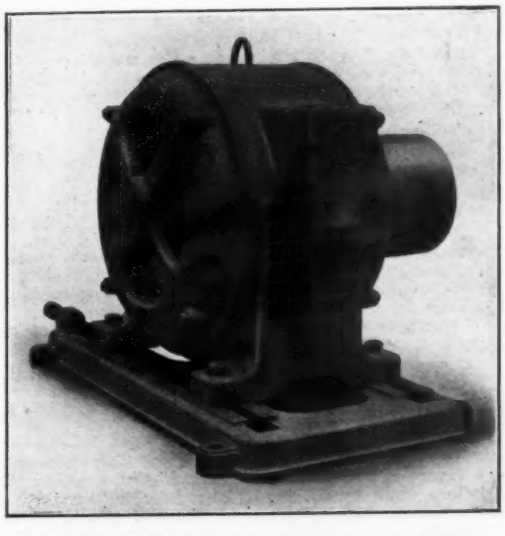


Fig. 4.—A Protected "Dual-Frequency" Motor.

that of the Company's standard motors, except for the provision of an additional terminal box. The motors are also constructed in various forms, protected, enclosed-ventilated, drip-proof, and so on. Fig. 4 shows a "Dual-frequency" motor of the protected type.

Correspondence.

Correspondents should forward their communications **as early as possible.** *No letter can be published unless we have the writer's name and address in our possession.*

Wanted—a New Word.

I feel that in view of the possibility of some of the terms quoted under this heading being taken up in a haphazard manner by your readers, a vigorous protest is necessary.

At all costs we must avoid words which are likely to lead to misunderstandings, and the majority of the suggestions are of this type. Your leader of June 1st points out that the use of the word "Kelvin" has been inconsiderable, and the fact that the B.E.S.A. glossary gives preference to "Unit of Electricity" is sufficient evidence that engineers prefer the descriptive name.

The various quantities (kVA-hours, reactive kVA, &c.) are not so often used that the lengths of the terms are troublesome; indeed, in many cases where it is necessary to refer to active and reactive kVA it is desirable to emphasise the names of the components, and for this reason the two terms are used in preference to "kilowatts" and "reactive kVA," which appear to be disconnected. The B.E.S.A. glossary gives the following:—

General terms: Voltage, current, volt-amperes.

Active components: Active voltage, active current, active volt-amperes.

Reactive components: Reactive voltage, reactive current, reactive volt-amperes.

These terms may be extended by the addition of the prefix "kilo-," or the suffix "-hours," or both, and, of course, other modifications of a similar character may be used. Surely it is not necessary to extend this list by the addition of synonymous terms? It is true that "reactive kilo-volt-ampere-hours" is cumbersome, but it is always written in the abbreviated form—reactive kVAh. It is usually read as "reactive k-V-A-hours" also, which is not objectionable, and gives proper emphasis.

The root of the matter is that the engineer who hesitates to say what he means does not really know what he wants to say, and he might very well spend five shillings on a B.E.S.A. glossary to find out. I sincerely hope that no new words which may be suggested will be adopted without very careful consideration and a proper sense of responsibility.

H. E. Dance.

Birkenhead, *June 9th*, 1928.

Referring to correspondence initiated by Mr. R. O. Kapp, may I offer the following suggestion for the names of the quantities under discussion:—

That corresponding to the term

POWER for the quantity measured in watts, we use

"ACTIVITY" for the quantity measured in volt-amperes

and

"REACTIVITY" for the wattless component,

the three corresponding respectively to the three quantities of another nature, *viz.*:—

Resistance, impedance, and reactance.

With regard to the names of the units of "activity" and "reactivity" corresponding to "watt" for power, I venture to suggest "voam" (short for volt-ampere) for "activity" and "kapp" for "reactivity." The latter would seem suitable in view of the work of Gisbert Kapp on the subject of power-factor correction, and also in view of its similarity of form to the word "watt."

We should then have:—

ACTIVITY (Voams)^2=POWER (Watts)^2+REACTIVITY (Kapps)^2.

We also have:—

Kilowatts (kW), kilovoams (kVA), and kilokapps (kK), kilowatt-hours (kWh), kilovoam-hours (kVAh) and kilokapp-hours (kKh).

Simple names for the last three seem difficult to suggest. Are they necessary in addition to the bracketed abbreviations?

I have previously used the name "activity" as seemingly very suitable for the quantity measured by volt-amperes. The name "reactivity" for the "wattless" component of that quantity is a more recent conception.

E. Fowler Clark, B.A., B.Sc., A.M.I.E.E.

Derby, *June 15th*, 1928.

Super-pressure Cables.

In a report in the *Electrical Power Engineer* (May, 1928) of a lecture given by Dr. N. A. Allen in London recently he is made to say, with reference to cables of special types of structure—

> "There have been types designed to reduce the working stress, and these are not necessarily successful, since the reduction of stress alone is not a solution of the difficulty, or at least the *rather small percentage reduction of stress* which is available by this means."

I can only assume that, in making this statement, Dr. Allen cannot have appreciated what can be done with a plain intersheath cable. If he will compare a plain intersheath cable made under my latest patents (which involves the finding of additional copper space to obtain 45 per cent. increased thermal dissipative capacity), with a Standard Underground Co.'s cable, as exploited at Newark, he will find that in the former cable the voltage can be raised to 190,000 V, as against only 132,000 V in the latter, for what is virtually identically the same diameter (within 2 millimetres), and employing the same limiting potential gradients.

It is possible that Dr. Allen's attention has been so exclusively concentrated upon 33,000- and 60,000-volt cables (where the gain by intersheaths is very decidedly less marked) that he really has not appreciated the very considerable gain there is when we get to cables of 190,000 volts; but, in that case, the statement in his paper should surely bear some qualification indicating these limitations.

As regards the other disadvantage alluded to, later, by him, I would like to say that, referring to the plain intersheath (three-core) cable, I have had quotations from leading cable makers which indicate that the difference in cost is quite small, certainly nothing in the least comparable with the gain in power-transmitting capacity, when the thermal constants obtained under my patents are also taken into consideration.

A. M. Taylor,
Major, S.O.2.

Birmingham, *June 12th*, 1928.

Electricity Tariffs.

The surprising amount of misunderstanding there seems to be over tariffs in vogue to-day prompts me to make a few remarks. One could expect misunderstanding with regard to the maximum demand system, owing to the difficulty of explaining its peculiarities, but there is really little, or no, excuse for misunderstandings with regard to the common flat-rate and the two-part tariff. Take the following cases:—

Flat Rate.—Lighting, say, 5d. per kWh, and power (heating, &c.), 1d. The same undertaking might offer a two-part tariff as follows: 12½ per cent. ratable value, *plus* 1d. per kWh for any purpose, *i.e.*, lighting, heating, and power, or *n*d. per 100 sq. ft. of floor area, *plus* 1d. per kWh for any purpose.

The misunderstandings seem to occur mostly when the undertaking offers a two-part tariff as well as a flat-rate, the chief mistake being that the flat rate is often supposed to be part of the two-part tariff!! Why such should be the case is not obvious.

Common sense ought to dictate that *if* a consumer has to pay a lump sum per quarter (*i.e.*, the 12½ per cent., or *n*d. per 100 sq. ft.) he naturally ought to have to pay *less* per kWh consumed, instead of 5d. per kWh *plus* the lump sum!

The *raison d'être* of the lump sum is beyond the scope of this letter, and the fact that it remains is sufficient to suggest that the price of the kWh ought to be less to offset it. No technicalities are needed to prove this. Nevertheless, the sooner all our undertakings in this country come to their senses and offer some alternative tariff to the flat-rate, the better for the consumers generally, especially in large towns and cities.

Tariff.

June 11th, 1928.

Stays for Section or Angle H-Poles.

I quite agree with "Lino," that an angle pole should be held by a stay, pulling against the angle, or, in other words, a stay in the same direction, and in opposition, to the resultant of the pulls exerted by the parts of the line each side of the pole. In fact, I would go further and say: Why put stays each way of the line at all? The probable cause of the pole being pulled over at the head, in the case cited by "Lino," is due to the fact that stays attached each way of the line cannot be made off round the pole at the "centre of gravity" of the pulls, but much below it, because of their coming too close to the conductors, and thus the pole bends over from the point of attachment. A stay bisecting the angle, however, would be right away from the conductors, and could be attached at the "centre of gravity" of the pulls.

Again, a pole stayed each way of the line is subjected to four sets of strains, which are obviously more difficult to balance than only three sets, as in the case of a pole stayed against the angle. Then there is the obvious advantage of the saving in the number of stays required. For example, a 120-deg. angle pole would only require one stay against the angle, to procure the same result as two stays, one each way of the line. The only argument in favour of stays each way of the line appears to be that if one of the conductors broke on one side of the pole, the latter would still remain vertical, on the same principle as a terminal pole. But why take more care over guarding against the results of such an uncommon occurrence as breaking wires near an angle pole than on any other type of pole? For if a conductor broke on one side of a line pole, and the binders were tight, the pole would give, and probably one or two other poles as well, each side of the break. If the same meticulous care is to be exercised equally throughout, every line pole should be stayed each way of the line as well, and there would be no end to the bugbear of stays.

H. M. Price.

Birmingham, *June 16th*, 1928.

Directional Wireless Marine Navigation.

We shall be glad if you will allow us to refer to an article on "Directional Wireless Marine Navigation," by Dr. R. L. Smith-Rose in your issue of June 8th, and to point out that it gives an incomplete survey of the direction-finding position as no mention is made of the important fixed-loop method of directional reception employed in the Marconi-Bellini Tosi system.

As the Marconi-Bellini Tosi fixed-loop method is used on 480 British ships, exclusive of ships registered in the Dominions, India, and the Colonies, out of a total of 645 British ships fitted with direction finders, the statement in the first paragraph of the article referred to, namely, "it may be said that practical direction finding by wireless is limited to the use of a rotating closed-loop aerial for either the transmitter or receiver," is absurd.

With regard to the relative advantages and disadvantages of the broadcast beacon and ship d.f. method, as compared with the rotating-frame beacon method, the case from the mariner's point of view has been ably put by Captain Sir Arthur Clarke, K.B.E., in a paper read at the Royal Society of Arts on February 15th last, entitled "Trinity House—Its History and its Work." While each method has its own special features, the conclusions arrived at in this paper are distinctly in favour of the broadcast beacon and ship d.f. method.

Marconi's Wireless Telegraph Co., Ltd.
(ANDREW GRAY, *Technical General Manager.*)

London, *June 13th*, 1928.

[For an abstract of Sir A. Clarke's paper see ELEC. REV., May 4th, 1928, p. 798; also see ELEC. REV., January 20th, 1928, p. 123.—EDS. ELEC. REV.]

The N.W. Midlands Electricity District.

Order of Constitution and Establishment of a Joint Electricity Authority.

THE Electricity Commission, having provisionally delimited an area forming parts of the Counties of Chester, Salop, and Stafford as a separate electricity district for the purposes of the Electricity (Supply) Act, 1919, and having formulated a scheme for the improvement of the existing organisation for the supply of electricity therein, have now issued an order under Section 7 of that Act, following a local inquiry at Stoke-on-Trent,* constituting the North-West Midlands Electricity District and establishing a Joint Electricity Authority therefor.

Framed on similar lines to others of its kind, the Order limits the maximum amount of money which the J.E.A. may borrow for the purposes of the scheme to £1,500,000. The J.E.A., whose chairman need not be one of its members, will consist of 14 members appointed or elected by the following constituent bodies:—

(*a*) Authorised undertakers: Stoke-on-Trent Corporation, 4; Stafford Corporation, 2; Newcastle-under-Lyme Corporation, 1; Leek U.D.C., 1; Stone U.D.C., 1; Market Drayton Electric Light and Power Co., Ltd., and the Trent Valley and High Peak Electricity Co., Ltd., 1 (jointly).
(*b*) Local authorities not being authorised undertakers, 1 (jointly).
(*c*) Large consumers, 1.
(*d*) G.W. Railway Co. and L.M. & S. Railway Co., 1 (jointly).
(*e*) Workers in the industry, 1 (jointly).

For the purpose of the technical scheme, the Stoke-on-Trent Corporation's central power station and that of the Stafford Corporation may be transferred to the J.E.A. For the supply of electricity in bulk to authorised undertakers in the District, the standard will be three-phase alternating current, and the standard frequency 50 cycles per second. For transmission the standard pressure (between phases) will be, in the case of main lines, 33,000 or 22,000 volts, and in the case of secondary lines 11,000 or 6,600 volts. For affording supplies in bulk to authorised undertakers in the District and to supplement existing or sanctioned inter-connecting or bulk-supply lines, main or secondary lines will be established to inter-connect:—(*a*) Stoke and Leek; (*b*) Stoke and Congleton; (*c*) Stoke, Newcastle-under-Lyme and Market Drayton; (*d*) Stoke and Stone; (*e*) Stafford and Uttoxeter; (*f*) Stafford and Market Drayton; (*g*) Leek and Congleton; (*h*) Leek and Uttoxeter; (*i*) Uttoxeter and Burton-on-Trent as far as the boundary of the District. Provision is to be made for the establishment of such other lines as may be necessary for the development of the remaining parts of the District.

The Order (copies of which are obtainable from the Secretary of the Electricity Commission, Savoy Court, Strand, London, W.C.2) has been submitted by the Commission to the Minister of Transport for confirmation.

* ELEC. REV., May 25th, 1928, p. 926.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1926.

20,325. "Direct-current electrical supply systems at constant potential." H. Longton. November 20th, 1926. (240,916.)
30,357. "Television apparatus." Televisions, Ltd., and J. L. Baird. November 30th, 1926. (291,121.)

1927.

5,057. "Electrodes and secondary batteries." Hart Accumulator Co., Ltd., and W. Schofield. February 22nd, 1927. (291,138.)
5,126. "Electrically operated apparatus for railway signalling and the like." L. H. Peter, R. S. Abbott, and Westinghouse Brake & Saxby Signal Co., Ltd. February 23rd, 1927. (291,142.)
5,173. "Thermionic amplifiers and circuit arrangements therefor." H. J. Round. February 23rd, 1927. (291,143.)
5,285. "Mounting arrangements for automatic switches and the like." Automatic Telephone Manufacturing Co., Ltd., F. Kessler, C. R. Woodland and J. C. McCrindle. February 24th, 1927. (291,151.)
5,382. "Protective gear for alternating-current distribution systems." H. G. Bell and Metropolitan-Vickers Electrical Co., Ltd. February 25th, 1927. (291,155.)
5,472. "Cable and the like telegraphy." W. S. Smith, H. C. Channon and N. G. R. Partridge. February 26th, 1927. (291,157.)
5,529. "Electrically-driven vehicles." G. H. Fletcher, A. Tustin and Metropolitan-Vickers Electrical Co., Ltd. February 28th, 1927. (Cognate application 8,031/27.) (291,159.)
5,564. "Light-actuated electric generator." Westinghouse Brake & Saxby Signal Co., Ltd. September 14th, 1926. (277,610.)
5,879. "Devices for converting electric oscillations into mechanical vibrations, such as telephones." H. Wade (Naamlooze Vennootschap Philips' Gloeilampenfabrieken). March 2nd, 1927. (291,166.)
5,978. "Electric switch." G. A. H. Wootton. March 3rd, 1927. (291,168.)
6,059. "Thermionic valves." H. T. Livermore and V. M. Richmond. March 4th, 1927. (291,169.)
6,141. "Loud-speakers and similarly operating acoustic apparatus." C. Menkens. March 4th, 1927. (291,170.)
7,560. "Apparatus for treating the blood circulatory system by electrolysis." E. Northrott and J. W. Warford. March 18th, 1927. (291,177.)
8,094. "Amplification of electric currents." W. Harrison and T. Wood. March 24th, 1927. (291,184.)
8,949. "Automatic quick-make and quick-break electric switch operated by means of an organ moving backwards and forwards." J. Jericke. March 31st, 1927. (Convention date not granted.) (268,811.)
9,050. "Electric contact fittings for circuit-breakers and the like." G. Pailin and Ferguson, Pailin, Ltd. April 1st, 1927. (291,190.)
9,776. "Motor lamps." R. A. Muller. April 9th, 1927. (291,194.)
10,464. "Junction-boxes for electric conductors." Callender's Cable and Construction Co., Ltd., and A. E. Wilson. April 19th, 1927. (291,201.)
12,975. "Safety devices for use in connection with electrically-heated elements." A. L. Large. May 14th, 1927. (Addition to 269,969.) (291,216.)
13,387. "Type-printing telegraphic apparatus." A. Chorine. May 18th, 1927. (291,217.)
13,500. "Processes for the production of aluminium in electric furnaces." V. Verney and Soc. Italiana di Elettrochimica. May 19th, 1927. (291,219.)
14,060. "Electric supply systems, particularly for energising radio receiving apparatus from supply mains." Igranic Electric Co., Ltd., S. R. Wright and L. E. Currah. May 25th, 1927. (291,225.)
15,360. "Separating switch for high-voltage overhead lines." Rheinisch-Westfalische Elektrizitatswerk Akt. Ges. June 19th, 1926. (272,897.)
16,388. "Sliding collectors for electric current." J. F. de Tovaros. June 20th, 1927. (291,247.)
22,477. "Electric switches." E. Weber. August 26th, 1926. (276,686.)
23,419. "Electric switches." Siemens-Schuckertwerke Akt. Ges. September 10th, 1926. (277,328.)
24,858. "Electric overload tripping devices." International General Electric Co., Inc. September 21st, 1926. (277,973.)
26,718. "Levelling device for elevators." Waygood-Otis, Ltd. November 6th, 1926. (280,176.)
27,313. "Radio transmitters." Soc. Française Radio-Electrique. November 23rd, 1926. (281,234.)
28,058. "Electrically-operated liquid-fuel burning device." I. E. McCabe. December 6th, 1926. (281,619.)
29,141. "Electrically-driven floor polishers." Inventia Patent-Verwertungs-Ges. July 15th, 1927. (291,283.)
30,038. "Electric switches." A. Hill and E. Anderson. November 9th, 1927. (291,290.)
33,615. "Process for charging high-frequency melting furnaces." Hirsch Kupfer-und Messingwerke Akt. Ges. December 23rd, 1926. (282,656.)
34,274. "Radio signalling system." Dr. S. Loewe. December 18th, 1926. (282,445.)
34,783. "Electric cut-outs." British Thomson-Houston Co., Ltd. December 27th, 1926. (282,758.)
35,097. "Electric heating elements." J. F. Schleper. December 28th, 1927. (291,316.)

1928.

1,696. "Sound-reproducing devices." British Thomson-Houston Co., Ltd. January 29th, 1927. (284,323.)
2,696. "Electric cable." Soc. Anon. des Cableries & Trefileries. January 28th, 1927. (284,34.)
3,865. "Electrical signalling and/or controlling systems." Metropolitan-Vickers Electrical Co. Ltd. February 19th, 1927. (285,481.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be lodged within one month from June 13th:—

Zu4. No. 484,078. Class 6. Magneto-electric machines.—Robert Bosch A.G. Stuttgart. (British representatives: W. P. Thompson & Co., 12, Church Street, Liverpool.)

Bull Wires (letter and design). No. 488,070. Class 8. Electric cables and flexibles.—Standard Metals, Ltd., 59, New Oxford Street, W.C.1.

Framax. No. 490,922. Class 15. Advertising signs, made of glass.—Berry's Electric, Ltd., 85 and 86, Newman Street, Oxford Street, W.1.

Gecam. No. 491,287. Class 18. Electric lighting, heating and power installations, and electric and pneumatic bell systems.—General Electrical Construction and Maintenance, Ltd., 35, Cannon Street, E.C.4.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ABERDEEN.—Cathedral (£150,000); J. N. Cowper, architect.

ALDERSHOT.—Cinema and shops, High Street; particulars from W. J. May, Wellington Building Estate.

ASKRIGG.—Secondary school for North Riding E.C.; director of education, Northallerton.

AYLESHAM (Kent).—Additional 100 houses, Colliery Village, for Pearson & Dorman Long, Ltd.

BARNSLEY.—Extensions, warehouse and cornmill, Perseverance Estate; Barnsley British Co-operative Society, Ltd. Shop and stores, Doncaster Road; United Yeast Co. Partial construction new Town Hall; Corporation Property Committee. Welfare centre, New Street area; medical officer of health.

BATH.—Extensions to laundry, with heating installation, Frome Road House (£7,700), for the B.G.; C. J. Butlin, clerk.

BEBINGTON (Cheshire).—Secondary school (deposit £5 5s.); F. A. Browne, county architect, Newgate Street, Chester.

BEXLEY.—Houses (56), Central Avenue Estate, Welling, for J. Stevens & Sons. Houses (30), Bexley Heath, for Cox Bros. Milk distributing depôt, for the Royal Arsenal Co-operative Society, Woolwich.

BIRKENHEAD.—Church, for the trustees of Laird Street Baptist Church; secretary.

BIRMINGHAM.—New housing sites for 2,400 houses; City Housing Department. Waterworks (£660,000); water engineer. Junior school, Birches Green (£18,000); new block, Yardley Wood School (£15,000); new department, Bierton Road School (£18,400). School for Defectives, Hamilton Road; Education Committee.

BRADFORD.—Twenty-two houses, Bolingbroke Street; A. H. Farnish.

BRISTOL.—Twenty-eight houses, Sea Mills Estate; A. W. Norris. Elementary School, Horfield Housing Estate (£30,000); E. G. Padfield, Son & Co., Ltd. Temporary school, Horfield; Priest & Mullings, Ltd.

BURTON-ON-TRENT.—Tire factory, for Pirelli, Ltd., 144, Queen Victoria Street, E.C.4. Nurses' home (£10,000), for the B.G.; H. S. Askew, clerk.

CARLISLE.—Weaving shed, Harraby; T. Brown & Co., Ltd. Estate development, Harraby; Mr. Johnston, architect. Technical school, Tullie site; borough engineer. 128 houses, various sites; city engineer.

CHESTER.—Shops and houses, Hanbridge improvement scheme (deposit £2 2s.); C. Greenwood, city engineer, municipal offices.

CHESTERFIELD.—Business premises, Vicar Lane, for W. T. Parker; Wilcockson & Cutts, architects, 12, Saltergate (returnable deposit of £2 2s.).

CLEETHORPES.—Cinema, Brereton Avenue; W. S. Willis, architect, 138, Grimsby Road.

COVENTRY.—Extensions to Little Heath silk works, Chapel Lane, for Courtaulds, Ltd.

DARLINGTON.—Extensions, with overhead travelling cranes (£40,000); Whessoe Foundry & Engineering Co., Hopetown.

DONCASTER.—Drapery premises, Scot Lane, for Donald Boulter; T. H. Johnson, architect. Telephone exchange, for H.M. Office of Works, King Charles Street, London, S.W. Ward pavilion, Royal Infirmary; secretary.

EDINBURGH.—School at Saughtonhall Mains, for Education Authority; J. A. Carfrae, architect. Open-air school, for Education Authority; B. Widdows, Derbyshire, architect. Advanced division and intermediate school in Gilmour Place (£6,500); clerk, Education Authority.

FARNBOROUGH (Kent).—Salvation Army Hall, Gladstone Road; O. Archer, architect.

FOLESHILL (Coventry).—Cinema, Holbrooks Lane; J. Bass, architect, Bedworth; Kelly & Sons, builders.

GARSTON.—Factory; Watford Ideal Homes, Ltd.

GILLINGHAM (Kent).—Hall and extensions, for Wigmore Working Men's Club; F. B. Hooper, architect.

GLOUCESTER.—Eighteen electricity sub-stations for the T.C.; Stratton Davis, Yates & Dolman, architects, 12, Queen's Square (returnable deposit of £2 2s.).

GRIMSBY.—Extensions to hospital (£9,420); H. G. Whyatt, borough engineer.

HAZEL GROVE (Stockport).—Laundry, Macclesfield Road, for the Hyde and District Co-operative Laundries' Association, Ltd.; secretary.

HENLEY-ON-THAMES.—Houses (30), for R. Wilson.

HEREFORD.—Alterations and additions, Shirehall, for Herefordshire C.C.; R. B. Brierley, county architect, High Town (returnable deposit of £5 5s.).

HUSTWAITE (Yorks.).—Wesleyan Church; J. F. Todd, architect, Easingwold (June 27th).

IRISH FREE STATE (Waterford).—Electric lighting of Mental Hospital for the Committee of Management; Mr. Flanagan, C.E.

KEIGHLEY.—Re-instatement after fire (£14,000 damage); Scott Bros. (Keighley), engineers and toolmakers, Albion Works, Worth Village.

LEEDS.—Conversion of premises, Edgar Street, York Road, into handicraft and domestic science centre; Architect's Section, Education Offices, Calverly Street, Leeds.

LINCOLN.—100 houses, Popular Street, and Skellingthorpe Road, for the City Council; city surveyor.

LONDON (East Ham, E.).—Additions, factory, Trebor Works, Shaftesbury Road; J. S. Mellis & Co.

(Finchley, N.).—Sixty-four houses, various estates; U.D.C. surveyor.

(Eltham, S.E.).—Block of shops, Well Hall Road, for John Laing & Son, Ltd.

LONGFORD (Coventry).—Cinema; J. Bass, architect, Bedworth; Dobbs & Pegg, builders, Foleshill.

LYTHAM-ST. ANNES.—Girls' secondary school, for Lytham School Charities; T. T. Rees and R. Holt, architects, 64, Rodney Street, Liverpool.

MARKET HARBOROUGH.—Extensions, warehouse, St Mary's Road; Willey & Co., Ltd.

MORETON (Birkenhead).—Electric light installation, Christ Church; rector.

NOTTINGHAM.—Hospital for women, Peel Street (£35,000); secretary.

OLDBURY.—Additional housing scheme (325), Galton Estate, for the U.D.C.; W. Greenwood, surveyor.

OLDHAM.—'Bus garage extension; borough engineer. Cinema, Gregory Street; Renouprez & McLeod.

PERTH.—Nurses' quarters, &c., for Society for Relief of Incurables at Hillside Home; medical superintendent.

ROTHERHAM.—Extensions, Grammar school (£8,500); governors. Pattern store, Don Street; Guest & Chrimes, Ltd. Petrol depôt, Don Street; British Petroleum Co., Ltd.

ROTHWELL.—Housing scheme (32); J. Southwait, surveyor to U.D.C., Council Offices.

SOUTHAMPTON.—Girls' school (£12,250), for the borough E.C.; director of education. Alterations, &c., Portswood and Highfield Unionist Club; Charles J. Hair, architect, 23, Portland Terrace (returnable deposit of £2 2s.).

SOUTH SHIELDS.—Development, Harton Villa Estate; Davidson, Son & Sherwood.

STAFFORD.—Houses (40), for the T.C.; A. Powell, builder, Wolverhampton.

SWANSCOMBE.—Cement works; Associated Portland Cement Manufacturers, Ltd.

TILBURY.—Hospital extensions; Walsham, Ltd., builders, Grays.

TORQUAY.—Additional 200 houses for the T.C.; borough surveyor.

TREDEGAR.—Extensions, workmen's institute; W. Edgar Jones, architect, Rivoli, Park Row.

WARRINGTON.—120 houses, Bewset Estate; borough engineer.

WINDSOR.—Re-erection of portion of King Edward VII Hospital (£45,000); secretary.

WOLVERHAMPTON.—Houses for the T.C.; builders, A. M. Griffiths & Son, Ltd. (104), and A. Powell (62).

WORCESTER PARK (Surrey).—Church, Cheam Common Road (£10,000), for the Wesleyan trustees; W. Kelsall Armitage, architect.

WORTHING.—Housing scheme (30), for the T.C.; borough surveyor. Reconstruction of public baths, with pumping plant and steam apparatus (£12,185), for the T.C.; borough surveyor.

Photo. by Graystone Bird, Bath.

The Incorporated

Incorporated Municipal Electrical Association

ation at Bath, 1928.